CONSTRUCTION AUG 1 1 1905
DETROIT

LECTION DETROIT

AUG 1 1 1905
DETROIT

AUG 1 1 1905
DETROIT

McGraw-Hill Publishing Company, Inc. AUGUST, 1935

Price 20 Cents

BO'SON'S CHAIR supports operator during driving of 80 - ft. steel sheet piles, in pairs, for 3,000-ft. long cofferdam on west bank of Columbia River, in Washington, at site of Grand Coulee dam.

Let's Look at Cordeau --



Aackhammer Holes

CORDEAU PAYS

- 1. Simplified loading
- 2. Less Hazard
- 3. More work from your explosives
- 4. Better fragmentation
- Fewer but bigger shots (Equipment moved less often)

Write for the Cordeau Book.

Where the formation will permit a number of Jackhammer holes . . .

Where the location will permit a single large shot in place of a lot of small ones . . .

There is where you may find it profitable to use Cordeau-Bickford, the insensitive Detonating Fuse.

Cordeau acts as the detonating agent in each load, and connects all holes in one pattern that "goes" as a single blast. It carries a powerful detonating wave at a speed of approximately three miles per second, resulting in the practically instantaneous explosion of all loads on the line. A cap is attached at one end of the Cordeau pattern just before shooting, and is fired with fuse or battery.

Consider each of the five savings afforded by Cordeau—and add CONTROL . . . blasting *planned* for easy removal, *timed* to the fraction of a second.

Let's look at Cordeau for Jackhammer holes — and remember, it is a natural for well-drill, wagon drill, pocket and tunnel blasting, demolition, irrigation and submarine work.



ALSO SAFETY FUSE Since 1836

THE ENSIGN-BICKFORD COMPANY

SIMSBURY, CONNECTICUT

CB-15

TECHNOLOGY DEPT!

August, 1935—CONSTRUCTION METHODS

Opportunities for Construction Salesmanship

• Opportunities for salesmanship by engineers and contractors are presented by the recent amendment to the National Housing Act providing for extension of insured credit up to \$50,000 for modernization and re-equipment of apartments, multiple-family dwellings, hotels, office, business and commercial buildings, hospitals, schools and industrial plants. The former \$2,000 credit limit, applicable to individual homes, restricted modernization to simple, small-scale operations of the type not ordinarily undertaken by engineers and general contractors. Now, however, not only has the size of permissible loans been increased 25-fold but the scope of modernization has been broadened to include repair, alteration and reconstruction of commercial and industrial structures and the installation of equipment "adapted to the business conducted therein or necessary to the operation thereof." The fees of a consulting engineer are a permissible expense in any modernization program undertaken with insured credit under the amended National Housing Act.

Here, then, is a chance for engineers and contractors to go out and get business—to sell a prospective local client on the "Modernize-for-Profit" idea under the enlarged credit plan of the Federal Housing Administration. Turn to the specific examples of modernization projects illustrated on pages 36 and 37 of this issue. They should suggest similar opportunities for selling engineering and construction service in your locality.

Road-Building Straightjacket Loosened

 Prospects for a normal road-building program have been considerably brightened by official interpretations loosening the \$1,400-per-man-year straightjacket originally placed upon the expenditure of work relief funds for highway construction and grade-crossing elimination. Strict insistence on the \$1. 400 limit to cover labor, equipment and materials would, of course, have made impossible any hard-surface construction of modern highway types. A more liberal policy is now announced from Washington. The \$1,400 - yardstick henceforth is applied only to the funds supplied by the Emergency Relief Appropriation Act to determine the quota of men that must be taken from relief rolls. Regular Federal-aid money and state funds to match it are not subject to this restriction but may be combined with the emergency work relief funds to provide sufficient money for a normal construction program.

How the revised plan works out is clarified by the following specific example cited by the American Road Builders' Association: Assume that a state, under the Emergency Relief Act, receives \$9,347,797 for highway work.

Construction Methods

McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York

ROBERT K. TOMLIN,

AUGUST, 1935

WILLARD CHEVALIER, Vice-President

Editorial Staff: Vincent B. Smith, N. A. Bowers (San Francisco).

Leonard H. Church (Cleveland), Netle Fitzgerald



Brown, in New York Herald-Tribun

C 1935, New York Tribune, Inc.

China Eggs Won't Hatch— Put Real Ones Under Her

This amount divided by \$1,400 gives 6,677, the number of men or state quota that must be employed from relief rolls. The same state, however, has been allotted \$5,348,062 as regular Federalaid and has matched this amount with a similar sum. The road-building funds from all sources, therefore, total \$20,-043,921 which, divided by \$1,400, makes available \$3,000 per-man-year, an amount more than sufficient according to an analysis of records of many millions of dollars of state highway construction, to insure a normal program of road building, as it takes only about \$2,000 for each payroll employee to build highways of modern types. Consequently, where a state can provide funds to match its regular Federal-aid allotment, there need be no curtailment of normal road-building activities.

Construction Atmosphere Is Clearing

• A number of rifts are appearing in the dark clouds which have been hanging over the works program and rays of sunlight are actually breaking through to cheer the construction industry. What promised to be a vast, ineffective operation of "made work," of little or no permanent value, even if it could have been undertaken on a scale and in time to provide substantial unemployment relief, is assuming more constructive form. Complete dominance by the Works Progress Administration and its welfare-worker point of view has been broken by the recent Presidential ruling limiting to WPA "small works" and "non-construction" items costing \$25,000 or less and assigning to the Public Works Administration projects involving expenditures exceeding \$25,000. This means that on normal public works and highway projects normal contract methods will prevail and that individual projects will not be subject to work relief restrictions as to cost per-man-year.

A more liberal 45-per cent grant, superseding the former 30-per cent, is now available for PWA projects of non-Federal types and the remaining 55 per cent of the funds may be borrowed from PWA at 4 per cent if the sponsor is unable to obtain the loan elsewhere on more favorable terms. This policy has had the result of swelling the flow of applications to PWA, which is speeding them on to the Division of Applications of the Works Program.

New Rules for PWA Projects

· New rules facilitating the prosecution of relief works have been approved by the President. They effect a decentralization of PWA procedure by authorizing examination of projects in individual states, a simpler form of contract, advance payment of a portion of the 45-per cent federal grant and predetermination of minimum wage rates based on prevailing local rates. Important among the new rules is the abolition of the former PWA three-zone minimum wage scales for skilled and unskilled workers; now, wage rates on PWA projects are fixed by the borrower or recipient of a federal grant. Preference in employment must be given to persons on relief rolls who shall constitute 90 per cent of the number of workers on any project. The contractor, however, may continue to bring supervisory and administrative employees and key men on the job provided their number does not exceed 10 per cent of the total, and may dismiss any employee not qualified to perform the work for which he was hired. Hours worked are set at 8 per day and 130 per month, although in some cases a 40-hour week is permitted. Wherever practicable double shifts will be employed to speed construction and spread employment.

PWA Makes Good Showing

• In the meantime, announcements of employment created by the works program are misleading, as included in them is the CCC enrollment and other continuing activities. Allotments for WPA work programs in various states are small to date but continuous. PWA, however, is making a surprisingly good showing. Applications from local public bodies, numbering more than 1,800, propose construction of public works costing \$465,000,000. Many of these projects, on review, undoubtedly will go by the board, but the total already is close to half PWA's volume under its old program which covered 4,042 non-federal projects costing \$1,069,-173,057, of which 20 per cent is not yet under construction.

Why FORCE Them on Relief?

DURING THE last month the policies that are to govern the work-relief program have been revised to correct some of the evils cited in the July issue of this journal.

We have, for example, a distinction between useful public works, which are to be built by the PWA, and the work-relief jobs that are to be handled by Mr. Hopkins' Works Progress-Administration. Regular public works jobs that ordinarily would be handled by contract, are to be so handled; labor will be hired directly by the contractors and paid normal wages. On the work-relief jobs the "security wages" will apply.

So far as concerns the individual project, the impractical \$1100 to \$1400 per-man-per-year requirement is out, although it is expected that the low figures on many work-relief jobs will balance the higher figures on some of the public works projects and thereby maintain this average for the country as a whole. Those closest to highway conditions believe that the available volume of low-cost work plus the highway funds from other than relief sources now will make it possible for the highway departments to absorb their share of those on relief and yet carry on a normal construction program by normal methods.

Although these revisions of the original plan represent real progress and insure a substantial volume of normal construction through the work-relief appropriation, the industry still has a job to do. It must see not only that full advantage is taken of these revisions but also that the program is made even more reasonable and practical.

NE PROVISION that calls for modification is the requirement that 90 per cent of the labor employed on both PWA and work-relief projects shall come from the relief rolls. Something may be said for such a requirement on the "made-work" projects. These are undertaken to care for those on relief; the "security" compensation is in effect a substitute for a dole. But nothing can be offered to justify its application to PWA projects and other useful public works. It must be remembered that under the revised program these projects are to be handled by normal procedure and are expected to create works of long-term value to the communities that build them. For the most part they will be built under competitive contract, which will make some contractor responsible on the basis of an agreed price for quality, performance and speed. It is quite out of order, therefore, that the officials, engineers, contractors and others who may be responsible for such works should be handicapped by an arbitrary requirement that 90 per cent of their labor must consist of those who happen to be on relief.

If the administration wishes to make its public construction policy effective, both as to the production of worth while structures at reasonable cost and as to making a dent on its unemployment problem, it should revise this requirement, so far as concerns normal public works construction. To illustrate: one county in a western state shows only 404 on relief while it has 2881 unemployed. Of the latter 363 are on relief, leaving 2518 unemployed but not on relief. In the words of the County Judge:

"We have literally hundreds of people in this county who are on the ragged edge of the relief rolls; in fact, I just know that they are going partially hungry rather than suffer the humiliation of going on the relief roll. If these people are left out we are going to be literally forcing good men to go on relief and destroying their morale."

Many other like cases highlight another reason why this requirement demands revision. Whatever may be our social obligations to those who have been forced to accept relief, we still have an obligation to those other unemployed who have managed to carry on. Sustained by their pride and their courage they have held out in the hope that eventually they would land jobs. If it were not for these, with their self-respect and self-reliance, the relief rolls would be even longer than they are.

BUT NOW, as the nation, the states and the cities are undertaking to reestablish a normal public construction program, these men should not be disqualified because of their self-reliance in favor of those who may have been more unfortunate or, perhaps, may only have been less reluctant to become a public charge. On the normal public works projects, intended to create useful works by normal methods and to pay normal wages, there can be no reason for passing over the competent unemployed in favor of those who happen to be on relief.

A wise administration of the public works and work-relief programs will enable government not only to taper off the number of those on relief but also to taper off the psychology of relief. Here is a chance to provide some jobs for worthy and competent workmen who have kept themselves off the relief rolls, but this cannot be done if those jobs are closed to them. Certainly we shall not help to restore a premium on self-reliance and self-respect if we force the unemployed worker to qualify for relief before he can be considered for a normal job.

Willard Thevalier

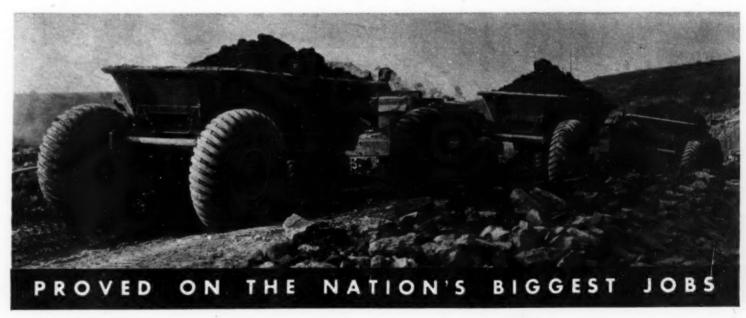
CONSTRUCTION METHODS. August, 1935. Volume 17, Number 8. Published Monthly, price 20¢ a copy. Subscription rates—United States, Mexico and Central and South American countries, \$2.00 a year. Canada, including duty, \$2.50 a year. All other countries, \$4.00 a year or 16 shillings. Entered a second class matter October, 1926, at Post Office at New York, N. Y., under the act of March 3rd, 1879. Printed in U.S.A. Cable address "McGrawhill, New York." Member of A.B.P. Member of A.B.P

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y. Editorial and Publishing Offices: 230 West 42d 8t., New York; 530 North Michigan Ave., Chicago; 885 Mission 8t., San Francisco; Aldwych House, London, W. C. 2, England, Branch Offices: Washington; Philadelphia; Cleveland; Detroit; 8t. Louis; Boston; Greenville, S. C. James H. McGraw, Chairman of the Board; Malcolim Muir, President; States 11, McGraw, Ly, Expectative View-President; Willard Chevalier, View-President; B. R. Puttann, Treasurer; D. C. McGraw, Secretary, Secr



Here is a thrilling picture portrayal of Euclid use and performance on fourteen history making dams, together with related relocation projects, that are refashioning and reclaiming extensive areas by taking control of natural elements in thwarting the ravaging effects of flood water destruction. Dirt moving involved on work of such magnitude runs into millions of yards. Fills, dikes, levees and embankments of unusual proportions are common to each of these undertakings. Obviously the work is out of the ordinary and must be expedited with exacting precision and strict economy in every operation. It follows that the exceptional variety of conditions and requirements encountered, establish the superiority of equipment selected on the basis of surpassing performance. TRAC-TRUKS moved in almost at the moment ground was broken on the first of these mammoth construction jobs. Their use from then on in rapidly mounting numbers is an interesting story by itself and a revelation of unequalled hauling costs and economies. Tappan, Clendening, Senecaville, Charles Mill, Leesville Dams—and so it reads in recounting some of the locations where these extraordinary dirt movers may be witnessed in operation. Write for the new Euclid Pioneer that describes and illustrates fully the use of Trac-Truks on the Ohio Dams.

THE EUCLID ROAD MACHINERY CO. . . CLEVELAND, OHIO, U. S. A.



We started to write this ad there shovel ads are as much alike as those famous quintuplets all talk of crowding the Sank :. 2 ... line SPEED and pull and all that. sooooooh we decided to throw our copy in the waste basket and and let some real action pictures of american Topker Shovels on the job" tell their own convincing story. We refer to our new Roto-Picture Magazine - american Topher Shovels Illustrated a free copy is awaiting you. Tear off Corner of this ad and sign your name and AMERICAN HOIST & DERRICK. CO.-ST. PAUL, MINN. address of contractors, INDUSTRIAL AND R.R. EQUIP. BUILDERS OF SHOVELS SINCE 1905

"What! No Graphs or Slide-Rules?"

REMEMBER the man who apologized for writing a 5-page letter because he didn't have time to write it in one? That explains this book—it tries to do a one-page job with a 5-page subject. It sums up good concrete practice, for the convenience of the concrete man on the job—without benefit of graphs or slide-rules . . . Yes, we've an axe to grind—but it's really your axe, too. Because this book also tells why 'Incor' 24-Hour Cement makes it easier to get good concrete—and get it at lower cost. 'Incor' combines with water 5 times as fast as ordinary cement. That means working strengths in 24 hours or less—watertight curing in 48 hours, instead of 10 days. 'Better Concrete' gives the facts—write for free copy. Address 'Incor' Cement, Room 2203, 342 Madison Ave., New York. 'Incor's is made and sold by producers of Lone Star Cement, subsidiaries of International Cement Corporation, New York; also sold by other leading cement manufacturers. *Reg. U. S. Pat. Off.

TABLE I: OUTLINE OF GOOD JOB PRACTIC

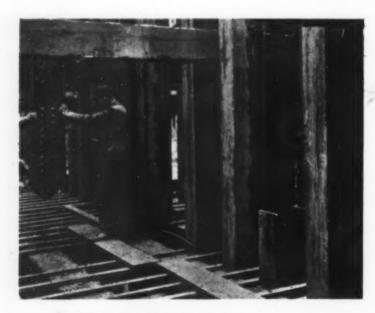
'INCOR' 24-Hour Cement

Keep a'bangin'



● When you're driving CB Bearing Piles, you know what your conditions are at all times. The steel has predetermined physical qualities. It isn't subject to splitting or shattering even under hard driving conditions . . . and steel piles will penetrate in rocky, gravelly soil.

Experience with CB Bearing Piles merits your investigation in any situation where the character of the soil presents unusual driving difficulties. Further data will be supplied upon request.

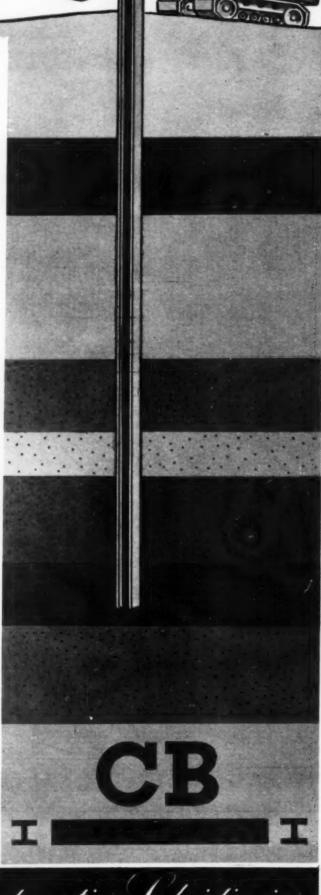


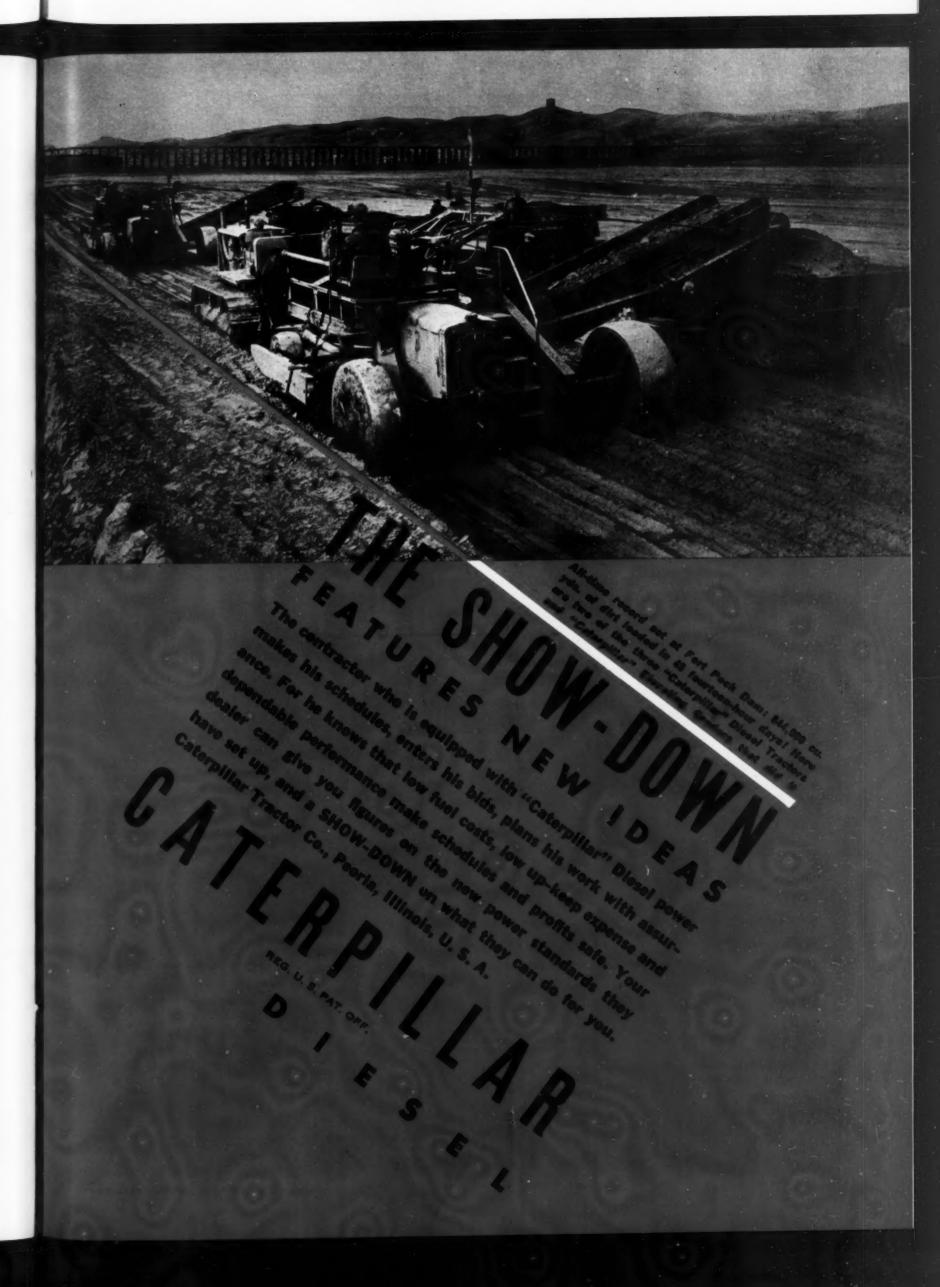
IN SPOTS LIKE THIS ...

Where unforeseen soil conditions are encountered far underground, you can drive CB Bearings to substantial footings confident in the knowledge that no damage can be done to the piles which will affect their long life or their load capacity.

ILLINOIS STEEL COMPANY 208 SOUTH LA SALLE STREET, CHICAGO, ILLINOIS

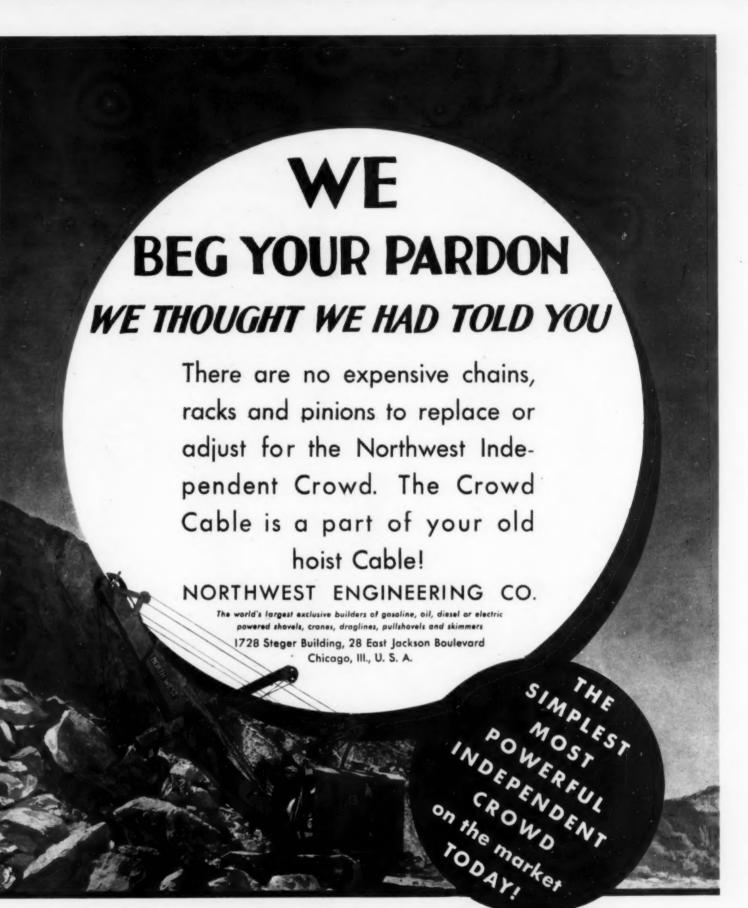
CARNEGIE STEEL COMPANY, PITTSBURGH





The MODERN TREND in MATERIAL HANDLING





SHOVELS, CRANES DRAGLINES PULLSHOVELS SKIMMERS

NORTHWEST

GASOLINE, OIL DIESEL OR ELECTRIC

BUILT IN A RANGE OF 10 SIZES-1/2 YD. CAPACITY AND LARGER

notice the sureness with which the dipper holds the grade, the freedom with which the sit is safely dropped into the pit, the swift thrust through the bank, the invariable heaped load, the quick acceleration of the swing, the sharp stop over the truck and the quick dump. You can't get speed like that without accurate, effortless control . . . and Bucyrus-Eries have it to a superlative degree.



BUCYRUS-ERIE

EXCAVATING, DRILLING, AND MATERIAL-HANDLING EQUIPMENT...SOUTH MILWAUKEE, WISCONSIN

Page 12

August, 1935—CONSTRUCTION METHODS

IN DUST, DIRT AND MUD

THE New GULFLUBE

can take it!



Refined by Gulf's Multi-Sol Process, this tough new oil helps keep contractors' equipment on the job without delays

HERE is an easy way to help your equipment perform at top-notch efficiency!

The new Gulflube Motor Oil, the only "regular" priced motor oil on the market made by the Multi-Sol process—gives a new measure of protection against wear, breakdowns and repair expense.

Gulflube is a good "buy"— a premium oil sold at a moderate price. If you are looking for an oil that will last longer, minimize carbon deposits, and give you the lowest possible maintenance costs, use Gulflube. It is the finest motor oil ever offered at its price. [Gulflube sells at 25c per qt. at retail service stations—somewhat lower in drums.]

GULF REFINING CO., Pittsburgh, Pa.

District Sales Offices: Boston · New York · Philadelphia · Atlanta New Orleans · Houston · Pittsburgh · Louisville · Toledo



This bottle contains the paraffine base charging stock which goes to the Multi-Sol plant. Along with the high quality oil of the paraffinic series which it contains are impurities, such as asphaltines and petroleum resins which are present in all crudes. These undesirable, readily oxidized impurities give the base stock a black color.

The colored portion of the oil in this bottle is the Gulflube Motor oil, taken from the quantity of lubricating stock shown in the other bottle. Below the Gulflube oil is the quantity of wax which is eliminated. In the bottom are the tars, gums, napthenic acids, petroleum resins and other impurities removed by the Multi-Sol process.

GULF REFINING COMPANY,
3800 Gulf Building,
Pittsburgh Pa

Would you like to have price quotations and complete information regarding the new Gulflube Motor Oil?

	Sign	and	man	tmis	coup
Name					
Company					

Watch THE LINK-BELTWORK

The man who loves team play . . . the unison of an army on the march . . . will appreciate the perfect coordination of every individual part of the Link-Belt as it smoothly, quickly and easily forges through the toughest jobs . . . always living up to the Link-Belt reputation.

STABILITY-POWER-SPEED

LINK-BELT

SHOVEL-CRANE-DRAGLINE

0088-A

LINK-BELT COMPANY, 300 W. PERSHING ROAD, CHICAGO

Offices and Distributors in Principal Cities

From 3/4 to 21/2 yds. capacity, heavy-duty

built. Gas engine, Diesel, or electric

motor drive. All models can be shipped

loaded on a flat car without dismantling.



Know your Ropes

... This is a helpful hint, how to make wire rope last longer. Subsequent Wickwire Spencer advertisements in this publication will give other dollar-saving information. Tell us about your rope problem and we will give you the answer.

It's poor and often a dangerous practice to pick up old lead pipe or purloin babbitt metal from the tool room with which to mould rope end into the socket. The loss of strength

is appreciable. Only pure zinc poured at the correct temperature makes a terminal that is as strong as the rope itself. United States Government specifications recognized this fact and permit only new pure zinc used in socketing. Write today and request "Safety

Hints About Terminals." Don't waste your rope's strength.

WICKWIRE SPENCER STEEL CO., New York City; Buffalo, Chicago, Worcester; Pacific Coast

> Headquarters: San Francisco; Warehouses: Portland, Los Angeles, Seattle. Export Sales Dept., New York City.

WIRE ROPE by Wickwire Spencer



BOTH...STANDARD LAY AND WISSCOLAY PREFORMED.

Wickwire Spencer manufactures all sizes and types of Wire Rope in standard lays and preformed. Wisscolay preformed wire rope will often solve a wire rope application difficulty. Ask our engineers where and when it should be used. Send for a free WIRE ROPE BOOK. It will prove of great value.







Of you want SPEED!

The rugged design of I-Beam-Lok and arrangement of steel at upper surface permit use of the floor as soon as unfilled units are laid and welded.

In 3 working days, 2 seven-hour shifts each day, with 2 crews, one working from either end, 1400 lineal feet of I-Beam-Lok Armored Bridge Flooring, 18'8" wide, was installed on the downstream side of the Market Street Bridge, Harrisburg, Pa. Later, on the upstream side, only two days were needed, each crew laying 350 lineal feet per day!

I-Beam-Lok has many advantages, aside from its speed of installation. It is light in weight, yet extremely rugged, as it takes advantage of the strength of the I-Beam. The completed concrete



35 Hours were required for concreting

surface is armored, anti-skid, long wearing and free from the possible development of progressive cracks. Send for illustrated booklet.

I-BEAM-LOK Irmored

CARNEGIE

STEEL COMPANY · PITTSBURGH

United States Steel \$\subsect Corporation Subsidiaries

Pacific Coast Representatives:

COLUMBIA STEEL COMPANY

San Francisco

August, 1935—CONSTRUCTION METHODS

JAEGER Adjustable SPREADER







Also built with side discharge, 4 wheels.



Full 2-bag capacity, plus END DIS-CHARGE, speeds up production and cuts your costs by discharging direct into bridge forms, pouring walks, floors, alleys with swinging spout, saving street space, saving wheelers.

Big brother to the famous Speed King 7S.

WRITE FOR CATALOG N-35 AND NEW LOW PRICES

THE JAEGER MACHINE COMPANY . 800 Dublin Ave., Columbus, Ohio

Just Try This:

Try five holes with Apex on your next blast

APEX

-Any Explosive you are using

with Electric Blasting Caps with your usual method of detonation

of APEX blasting
in one quarry
was only .025
per ton

of Ammonia
Gelatin blasting
in the same quarry
was .031
per ton

Prove to yourself how much Apex saves you

For many a quarryman Apex has cut costs in production—in drilling—in shovel maintenance. Its balanced power offers new economies. Its new action stresses burdens and causes favorable breakage and fragmentation.

Apex may not be adaptable for every quarry but favorable reports of its action are being received from an increasingly large number of operations.

Apex may show equal or even greater savings in your quarry. A test will tell the story.

ATLAS POWDER COMPANY, WILMINGTON, DEL.

Cable Address-Atpowco

Everything for Blasting

Allentown, Pa. Boston, Mass. Butte, Mont. Denver, Colo.

Joplin, Mo. Kansas City, Mo. Knoxville, Tenn. Los Angeles, Calif. Memphis, Tenn. OFFICES
New Orleans, La.
New York, N. Y.
Philadelphia, Pa.
Picher, Okla.
Pittsburg, Kansat

Pittsburgh, Pa.
Portland, Oregon
Salt Lake City, Utal
San Francisco, Calif
Seattle, Wash.

Spokane, Wash. St. Louis, Mo. Tamaqua, Pa. Wilkes-Barre, Pa.

ATLAS





ALL ROAD EQUIPMENT MOVES FASTER!

Nour excavator is the spear head of attack on road construction jobs. If it fails, all equipment along the line may have to mark time. That's where P&H speed and stamina show up with continuous high speed production.

But it's not only freedom from breakdown that makes P&H performance so outstanding. It's Split Second Control with

"Sure Feel" power clutches that protect frame, motor, drums and gears from disabling shocks . . . Super Smooth Swing Clutches that provide faster, more accurate dipper spotting . . . Rapid Reversing Crowd Planetaries that speed up the digging cycle. The P&H chain crowd enables you to grade faster-within 1 inch of floor level. And you can keep it up

hour after hour because everything is designed for the easiest possible operation-to save tiring motions and get the most out of the day's work.

This year's road building jobs will be awarded on the basis of the lowest cost per mile. High speed equipment will figure in every bid. Contractors who have the advantage of

> these modern and advanced P&H features will be in the running on any job. That's why you should investigate them now. . . . There's a P&H working somewhere near you. We'll be glad to tell you where. Watch it hit its stride and see the difference. There's a model for every kind of road job. Write for details on specific sizes.

PAH BANTAM WEIGHT (Model 100-3/8-yd.)

A new, full-revolving machine that is lighter and faster with all-welded construction. Swift travel, easy steering and quick turning give it tractor mobility. P&H proved features give it dependable high speed production. It's fully convertible at a new minimum of expense. Bulletin No. 100 has complete specifications. Write for your copy.

CORPORA

Warehouses and Service Stations:

Los Angeles

San Francisco

ROA

MODEL 600 MODEL 650

11/4 Y D.

34 YD. 1 YD. AND UP TO 4 CU. YARDS

FOR faster BAT H HAU





DUMP TRUCKS

 The proven Hug Front Axle Rocker Action used on Hug Roadbuilders for five years is incorporated in all the new Hug Definite Purpose Trucks. This feature keeps Hug trucks on an even keel -there's no twisting or bending of frame, cab, hood or radiator, even in roughest going. Real riding comfort, too.

It takes more than a chassis and a dump body to make an efficient, economical dump truck. That's why all Hug trucks, are especially engineered and built to meet a condition.

Take batch hauling, for example. Here you need speed and easy handling plus sufficient capacity to cut the hauling cost per batch to aminimum. The Hug 19-DDefinite Purpose Dump Truck is equipped with a two batch body, a five speed forward transmission with overdrive, providing extra speed for the return trip empty. Its special design, including the famous Hug front-axle rocker action, ½-½ load distribution, short wheel base, short turning radius, 4-wheel hydraulic brakes assures easier operation even in the roughest going.

roughest going.

Put a fleet of Hugs on the job. Check performance and cost per mile, batch, or yard, days on and off the job — with any other equipment on the market — bar none.

The few minutes it takes you to answer this advertisement and send for full details on Hug Definite Purpose Trucks or Hug Roadbuilders may be the source of extra dividends for you this year. Hug trucks are available in capacities ranging from 1¾ to 10 tons, for every dump truck purpose; batch hauling, dirt and rock moving, elevating grader and quarry operations.

THE HUG COMPANY

526 CYPRESS STREET, HIGHLAND, ILL.

Built TO MEET A CONDITION

GET AN EXTRA PROFIT



... Base your estimate en AUSTIN-WESTERN MOTOR GRADER PERFORMANCE

 On oil mix estimates the particular qualifications of the Austin-Western "77" are a positive factor in winning contracts - and in carrying through the work to yield the expected profit.

The leading factor which will give an advantage in estimating, is the economical balance between speed and low fuel consumption. With a six-speed transmission permitting selection of the one most economical speed from 1.5 to 13 m.p.h. regardless of grade and type of material the general average of fuel consumption for this motor grader is $2\frac{1}{2}$ gallons per hour. Other points of working efficiency are hydraulic controls, Austin-Western dual (4 wheel) drive traction, resistance to side slip by the leaning front wheels, and firm blade free from chatter.

The particularly valuable feature of the "77"

to contractors is that it performs equally well on many other types of work-shouldering, grading, maintaining, scarifying, etc. It is a piece of equipment the road contractor can keep busy the year round on jobs of many classes.

The Austin-Western line as a whole offers those who specialize in bituminous surfacing a complete line-up of equipment—the Bituminous Distributor, a choice of materials handling units, and the famous Austin-Western Roll-A-Plane.

Check the coupon to indicate the machines on which you would like full details.

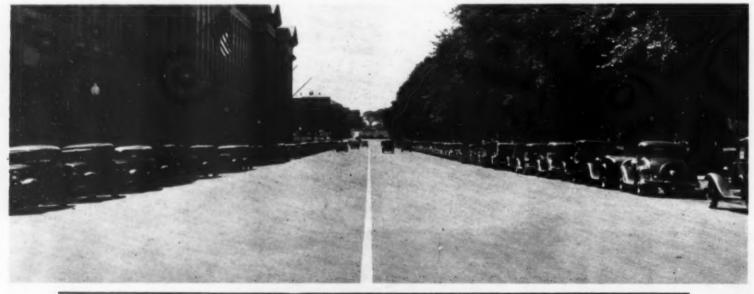
The Austin-Western Road Machinery Co. Home Office: Aurora, III. Cable Address: AWCO, Aurora
Branches in Principal Cities

end new Road Machine BITUMINOUS DISTRIBUTORS · ROAD-MIX MACHINES · CULVERTS SCARIFIERS . BULLDOZERS . TRAILERS . SCRAPERS . PLOW CRUSHING AND WASHING PLANTS . SWEEPERS AND SPRINKLERS . SHOVELS . CRANES . ETC . SNOW PLOWS

INDELIBLE



Which marker is two years older? These pictures of Atlas White traffic markers were taken the same week. They are reproduced exactly as taken—no "doctoring." Above is a marker installed recently, in asphalt, on Maryland Avenue, Washington. Below is a marker installed nearly three years ago, also in asphalt, on 15th Street, N. W., Washington. If you didn't know, could you tell which was the old, which the new? Atlas White traffic markers do stay white, indelibly white. No maintenance. No replacement cost. Write for complete information to Universal Atlas Cement Co., Subsidiary of United States Steel Corporation, 208 South La Salle Street, Chicago.



ATLAS WHITE TRAFFIC MARKERS

Made with Atlas White Portland Cement - Plain or Waterproofed

the under street street

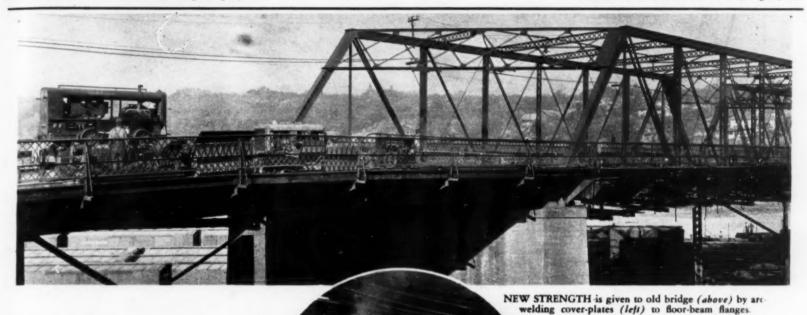
we end stiff

Construction Methods

ROBERT K. TOMLIN, Editor

Established 1919-McGraw-Hill Publishing Company, Inc.

Volume 17-Number 8-New York, August, 1935



Arc-Welding Strengthens 33-Year-Old Bridge

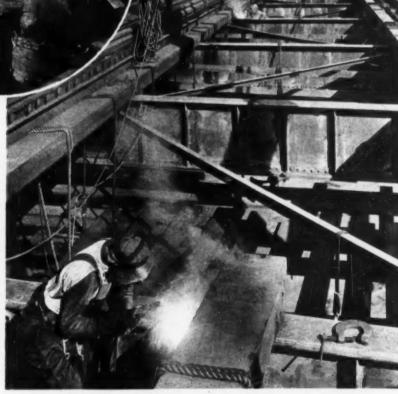
FTER having been in service for 33 years the floor system of the Union Pacific bridge at Omaha, Neb., has been strengthened by arcwelding to enable the structure to carry the heavy loads of today's increased volume of traffic. Floor beams and stringers have been reinforced by welding stiffener plates to the flanges of these structural steel members, and the old floor itself has been replaced with a new roadway of creosoted timber planks covered with asphalt.

Floor beams were strengthened by welding on cover-plates and web-stiffener plates, while stringer flanges were stiffened by welding in plate stiffeners. The top cover plates used were 25 ft. in length, 10 in. wide and ½ in. thick. Bottom cover-plates were 25 ft. x 14 in. x 7/16 in. Plates used for web stiffeners were 3 ft. 3 in. long, $4\frac{1}{2}$ ft. wide and $\frac{3}{8}$ in. thick.

Cover plates were attached by plug welds and continuous fillet welds. Webstiffener plates were welded in place by fillet welds on alternate sides of the plate to prevent bending of the stiffener.

After strengthening the stringer flanges and floor beams, the bridge was provided with a new floor. This consisted of a creosoted timber sub-floor, with flooring laid diagonally, and a plank wearing surface covered with asphalt.

Welding was done by Teleweld, Inc., Chicago, using equipment and electrodes manufactured by the Lincoln Electric Co., Cleveland, Ohio.

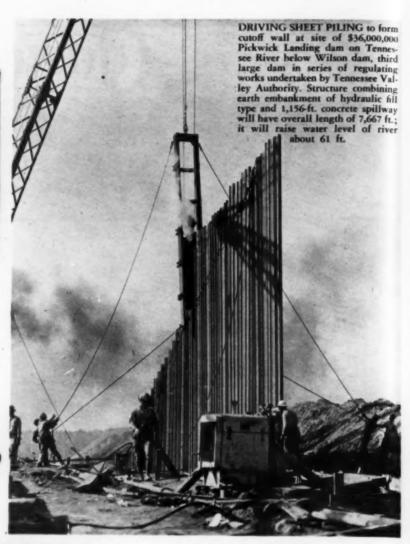


OLD FLOORING REMOVED to allow stiffening cover-plates to be welded to floor beams. Plate stiffeners still remain to be welded in place vertically on floor beams.



PALACE OF WATER, housing presentation of story of Colorado River aqueduct by Metropolitan Water District of Southern California and other Pacific Coast water projects, is feature of Pacific International Exposition at San Diego. Feature of exhibit is 100-ft. long diorama, combination relief map and painted background, picturing Southern California's great water projects.

This Month's "NEWS REEL"





NEW BRIDGE and approaches to Saugus River crossing on Shore Road eliminates hazardous grade crossing at intersection of state highway and tracks of Boston, Revere Beach & Lynn Railroad at Revere, Mass. Structure is financed by PWA allotment of \$100,500. Contractors are Crandall Engineering Co., Boston, for substructure and McClintic-Marshall Corp., Bethlehem, Pa., for superstructure. Work is under direction of Massachusetts Department of Public Works, A. W. Dean, chief engineer.



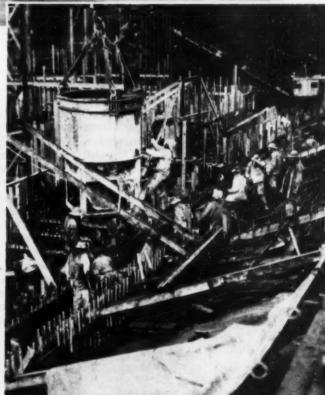
August, 1935—CONSTRUCTION METHODS



CONCRETING AT NORRIS DAM, T.V.A. project on Clinch River in Tennessee, is well along toward completion. Pouring to finish estimated yardage of about 1,000,000 is being done alternately at two remaining openings in structure. Six-yard cableway buckets, filled from special transfer cars, place concrete, as described in Construction Methods for October, 1934.



TAPPAN EARTH-FILL DAM is first of fou teen structures for flood control and river regulation in Ohio undertaken by Muskingum Watershed Conservancy District with initial allotment of \$22,590,000 from PWA. Euclid Trac-Truks deliver earth for Sammons-Robertson, Inc., contractor of Huntington, W. Va., on \$387,450 contract involving about 400,000 cu.yd. of impervious fill in 6-in, layers.



SIX-YARD BUCKET delivers concrete to forms for power-house substructure at Bonneville dam, power and navigation project on Columbia River, 45 mi. east of Portland, Ore. Power-house and lock contract, involving 240,000 cu.yd. of concrete, is held by General Construction Co.—J. F. Shea Co.



SLUM CLEARANCE makes progress at Atlanta, Ga. where buildings of Techwood low-rent Federal housing project take form as result of \$2,700,000 allotment from PWA. Project comprising 22 buildings will provide homes for 604 families in lower-income group. Under Housing Division of PWA, J. A. Jones Construction Co., of Charlotte, N. C. has general contract for project, amounting to \$2,108,337.

orm 000 nesoird ing /al-

fill ft.; ver

ork rack stral den, t by Co., e in

ODS



TARTING WORK on nineteen concrete bents for the Queens approach to the Triborough Bridge, York City, in the last week of September, 1934, Rodgers & Hagerty, Inc., of New York, the contractor, prepared a construction schedule involving rapid and economical re-use of column forms to obtain completion of the work 2 months in advance of the contract date (March 1), thus escaping the severe winter weather of January and February. Accurate and simplified charts were prepared by the contractor's main office to guide the fabrication, stripping and reconditioning of forms in the field. These charts, in conjunction with the simple and effective design of the forms themselves, aided the field superintendent and his working force in carrying the piers to completion within the short time desired.

Bridge Approach—Rising from a plaza at street level to the deck of a suspension bridge now under construction across the Hell Gate, between the borough of Queens and Ward's Island, the approach ramp is supported by nineteen structures ranging from a low retaining wall at the plaza to a three-column bent 60-ft, high at the junction with the main bridge. With the exception of the retaining wall at the plaza, the ramp substructure consists entirely of three-column bents rising 19 to 60

SYSTEMATIZED Expedites Work on Expedites

ft. above the ground, with the columns in each bent spaced 41½ ft., c. to c. Thirteen of the bents are capped with reinforced concrete beams having arched soffits between the columns. The five shortest bents have individual columns unconnected by concrete caps. Span lengths vary from about 60 to 90 ft. between centers of bents. The total length of the approach is 1,475 ft., from pier 1 to pier 19.

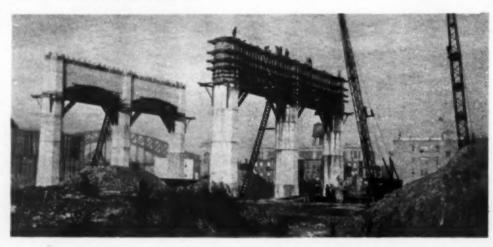
Columns of all bents are reinforced concrete octagons measuring 8 ft. in diameter (between flat faces) at the top. This dimension is increased by a batter of 1 in 90 from the top of the column to a vertical base plinth. The base plinths rise to varying heights above the rectangular concrete footings on which the columns rest.

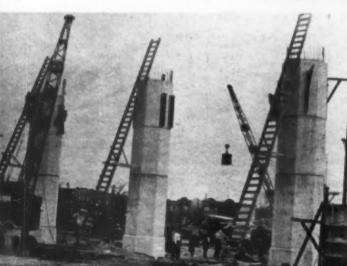
With the exception of the six tallest piers, which rest on spread footings, the bents and the retaining wall are supported by groups of precast concrete piles driven to an average penetration of 21 ft. For the pile foundations, the MacArthur Concrete Pile Co-p. drove 1,050 reinforced-concrete octagonal piles, measuring 16 in. in diameter between flat faces at the butt. These piles were cast by the Massey Concrete Products Co.

Each pier included a drainage system consisting in general of cast-iron pipes placed in the reinforced concrete columns and connected to sewers. Provision is made for later connections be-



SUBSTRUCTURE OF QUEENS APPROACH to Triborough bridge, New York City, comprises eighteen three-column bents constructed with field-fabricated wooden forms of special design. Cranes place concrete delivered by truck mixers.





TO SUPPORT ARCH CENTERS (left) for soffits of concrete cap beams, contractor bolts T-beams to inside faces of columns by means of special cones embedded in last lift of concrete.

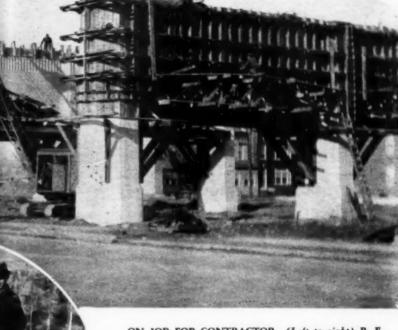
tween the cast-iron pipes and the deck drainage system. To take care of changes in grade affecting property on the north side of the right-of-way under the bridge approach, the plans provided a paved concrete ramp and retaining walls.

Earth excavation for the pier foundations amounted to 6,000 cu. yd., and 9,000 cu. yd. of fill was required for grade adjustments along the right-ofway. Precast concrete piling under 13 piers of the ramp totalled a little more than 22,000 lin. ft. Concrete in the pier PIER-CAP FORMS (above, left) for thirteen bents are supported by timber arch centers resting on steel falsework secured by bolts to concrete columns.

EDRE-USE OF FORMS

on Bridge Approach Piers

angle.
vertice
chann
tractor
the two
ing or
channel



ON JOB FOR CONTRACTOR. (Left to right) R. E. Allen, assistant engineer; William Kauffman, civil engineer; and A. Craig, iob engineer,—all of Rodgers & Hagerty, Inc.

SIDE FORMS (below) for entire bent cap consist of eleven pieces erected in 4 hr. Total concrete volume of 220 cu. yd. in cap puts load of 150 tons on each of two sets of centering.

angle. The panels consisted of 2-in. vertical sheeting placed against 15-in. channel wales picked up in the contractor's storage yard. Channel wales of the two panels on each side of a footing overlapped at the joint, and the channels were drilled with holes at the proper intervals to permit adjusting the side form to various lengths for the different sizes of footings. Pieces of 2-in. sheeting were added or removed as necessary in altering length of side form.

PRECAST

CONCRETE PILES

driven to 21-ft. average penetration support twelve bents and low retaining wall at entrance plaza.

essary in altering length of side form. Pier Forms—Height of column sections in the bents was set by the vertical interval between construction joints; in general, this height was 11 ft. As already noted, the columns were octagonal and were built on a slight batter above the base plinth. Column forms of octagonal shape were fabricated of 2-in, lumber in two halves and were lined with ½-in, plywood. According to the contractor, this lining eliminated 90 per cent of the finishing required with unlined forms.

The two halves of each column form unit were held together by steel bands made in two halves with bolted end flanges to permit easy stripping and erection. These bands resembled in appearance the semi-circular steel rings used in sinking caissons by the Chicago open-well method, with the exception that the end flanges were turned out instead of in. Horizontal ribs of the stiffening frames on the outside of the

column forms were cut on circular arcs to afford a continuous bearing for the steel bands. Each continuous horizontal rib of a complete octagonal form unit was made up of eight pieces of 2-in. board with the straight edges bearing against the flat face of the form and with the outside edges cut on the arc

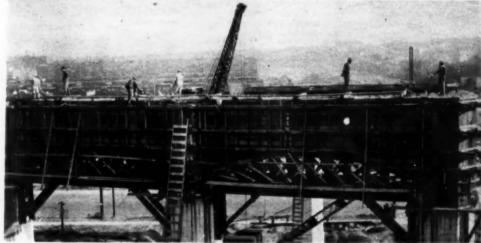
An 11-ft. column form was reinforced with six horizontal ribs, and the two halves were locked together with six pairs of semi-circular steel bands.

of a circle.

It was the practice on the job to set the forms for the three columns of a bent at one time and to place concrete in the three forms simultaneously. Erection, lining up and plumbing required 3 hr. per section. A form unit could be stripped in ½ hr. Three 11-ft. form sections held about 75 cu. yd. of concrete.

Cap Beams — Each reinforced-concrete beam capping the three columns of a bent contained 220 cu. yd. of concrete. When the beam forms were filled with concrete, they imposed a load of 150 tons on each set of centering between two columns. In designing the centering, the contractor utilized old 24-

ON BOLTED T-BEAMS (below), workmen place pair of 24-in. I-beams (Additionally supported by knee-braces) to carry timber centering unit for arch soffit of cap beam. Timber centers can be seen in background.



SEMI - CIRCULAR STEEL BANDS (left) bolted through end flanges hold two halves of octagonal column form unit. foundations amounted to 3,550 cu. yd., and concrete in the piers and beams above ground aggregated 6,340 cu. yd. The structures were reinforced with 365 tons of bar stee

Footing Forms — Rectangular footings under the piers varied in horizontal dimensions, no two bents having footings of equal size. Each footing form was made up in eight panels, with two panels for each side of the rect-



in. 133-lb. I-beams 40 ft. long which were stored in the yard. Two beams were used in each arch center. To fit the clear span of 32 ft, between columns, the beams were cut in 32- and 8-ft. lengths. The 8-ft. cut-off was ripped lengthwise in a shop to form two 8-ft. T-beams. As indicated by an accompanying drawing, two 8-ft. Tees were bolted to each column by means of Colt cones embedded in the last lift of concrete and additionally supported inside the concrete with 1/2-in. square rods bent in the shape of a hairpin and tied back to the main reinforcing with \%-in. rods 1 ft. long. Each T-beam was attached to the column by twelve cones, which were chosen for this service for two reasons. The cones had sufficient shearing strength to carry the load and they were so designed that they could be removed readily from the column long after the concrete had hardened.

Horizontal 12x12-in. timbers on top of the T-beam brackets supported the ends of the 32-ft. I-beams under each arch center. These timbers were made long enough to carry on their cantilevered ends a third I-beam which was used in stripping the arch center. Steel plates and wedges were driven under the ends of the I-beams to facilitate dropping the center when the time arrived to strip the forms.

Additional support was needed to reduce the bending moment in the Ibeams if only two beams were to be used with entire safety for the designed loading of 150 tons. The additional support was provided by bolting angle brackets to the lower flange of the 32ft. beam and to the 8-ft. Tee to permit installation of knee braces. On the steel beams was placed a timber arch center of 40-ft. radius having a floor of 2-in. sheathing covered by 3/8-in. plywood. The sheathing was nailed to three 3x-10-in, ribs which were blocked out with 6x6-in. timbers to the I-beams. Each arch center was internally braced to be

moved as a unit.

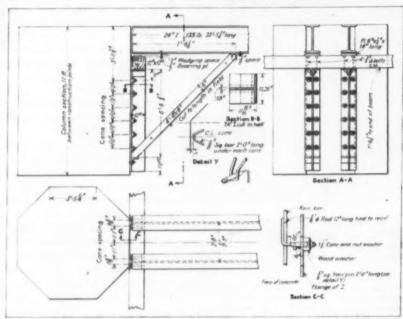
Side forms for an entire bent cap were made up in eleven pieces which could be erected in 4 hr. The octagonal shape of the columns extended into the cap, where the three octagons were intersected by the transverse beam of rectangular section. Ordinary methods of form construction were followed in casting the pier cap, utilizing timber wales and steel tierods with Colt cones, clamps, and nut washers.

In stripping an arch center, the timber center first was lowered by driving out the steel wedges under the ends of the 32-ft. I-beams. Workmen then shifted the center sideways until it rested principally upon the third I-beam supported clear of the pier by the two cantilever timbers. A truck crane lifted the center from this position and transported it to the next set-up.

Construction Schedule—As the first step in construction of thirteen of the piers, the contractor had to drive precast concrete test piles in five places. Fortunately the pile subcontractor already had sufficient piles on hand to make the tests. Driving of test piles started at pier 19 and finished at pier 7 six days later. Because of the cost of moving the heavy driving rig, it was advisable to leave the piledriver in this position to install the foundation piling

with the economy in mind of getting as many re-uses as possible while at the same time maintaining rapid progress on the job. The average number of reuses of forms was five.

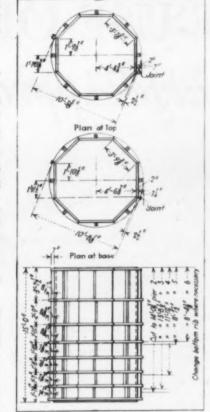
In all, 29 column form sections served the entire contract. The accompanying chart indicates the sequence in which certain forms were used. Three sets of form a, for example, were reused three times in the construction of base plinths of piers 1 to 4. The height of the base plinth from the footing to the beveled edge was varied by moving the bevel piece down inside the form. Form b, made up in three sets for the lower column sections of a bent, served six piers. The forms were cut down as required to fit the grade of the ramp. As the top diameter of the column section remained constant, the cut-off was made at the bottom.



DETAILS OF BOLTED VERTICAL TEES supporting I-beams under timber arch centers of pier-cap sofits. Cones cast in last lift of piershaft concrete (to permit bolting of T-beams) are removed after arch centers have been stripped.

for pier 7. Curing of the concrete piles required 30 days. Thus a total of 36 days (6 days for driving test piles from pier 19 to pier 7 and 30 days for curing precast piles for the foundation of pier 7) had to be utilized to advantage by the general contractor on piers 1 to 6.

A progress chart reproduced in part with these notes was made in the contractor's main office, detailing the number of forms and the sequence of using them. This schedule was drawn Placing Concrete—Transit-mix concrete delivered by 5-cu. yd. truck mixers was used for all structures involved in the contract. The 5-yd. drums mixed each batch for 5 min. at about 12 r.p.m. In general, mixing started after the truck had reached the site. The concrete mixture was designed on proportions of about 1:2:4 for cement, sand and coarse aggregate, and the volume of water was regulated to give a slump of 2 in. This relatively stiff mixture was placed



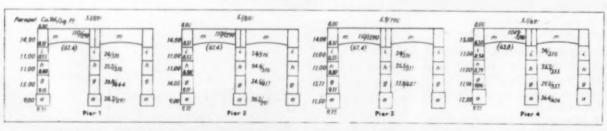
FORM g, in plan and elevation, with dimensions indicated for shortening form as it moves progressively from tall piers to shorter ones.

around the reinforcing steel in the forms with the aid of mechanical vibrators. In all, the contractor used on the work six types of vibrators, some driven by electric motors and others by gasoline motors. One of the vibrators was made by the contractor, but the others were manufactured products purchased in the open market. Of the six types, a Mall spud vibrator connected by a flexible shaft to a gasoline power plant proved the most satisfactory.

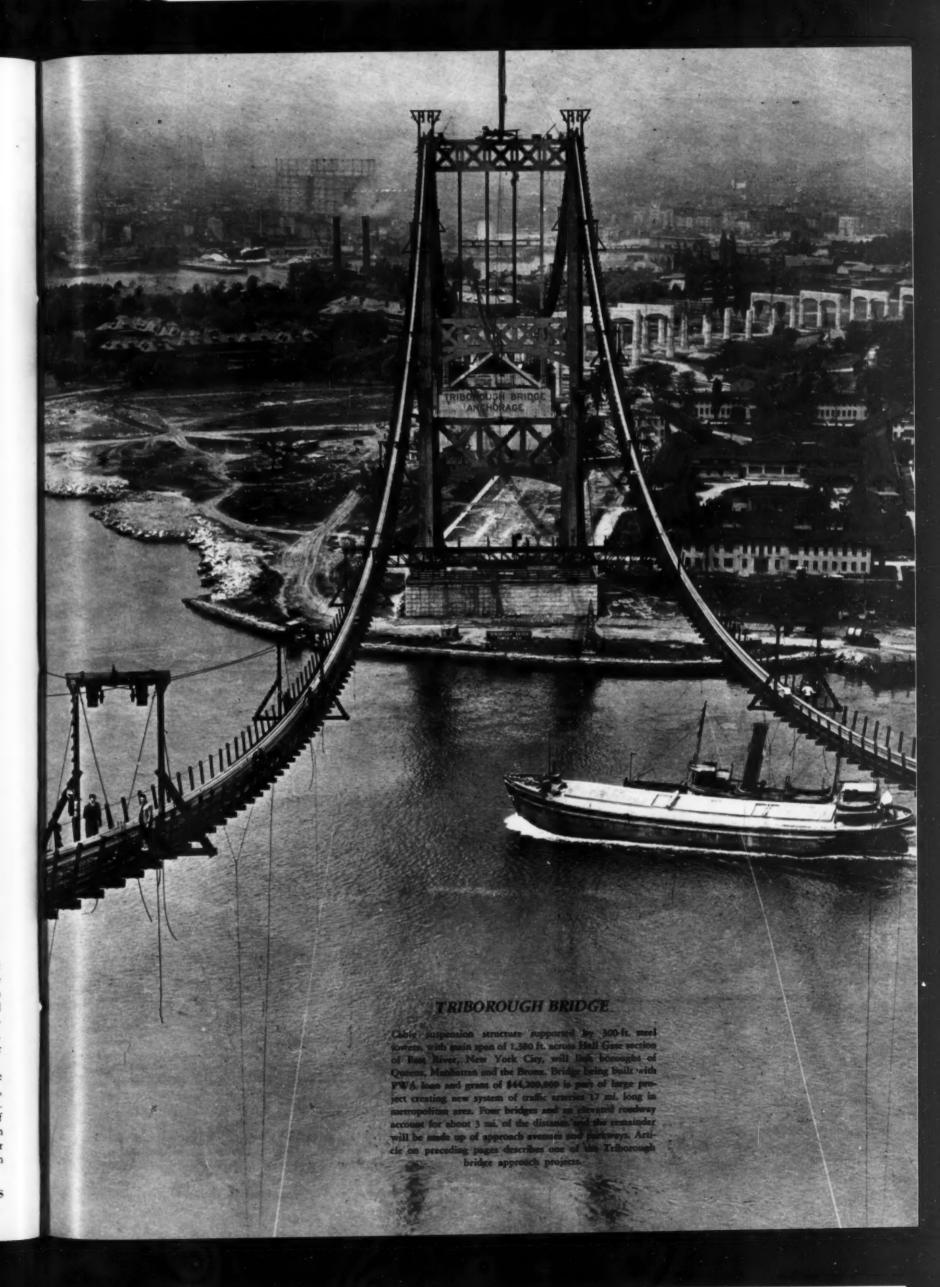
All concrete on the job was handled in 1-yd. radial-gate buckets by Lima gasoline crawler cranes equipped with booms of various lengths. Two of the cranes had 50-ft. booms, two had 75-ft. booms, and the fifth had its boom extended to 80 ft. to handle the work at the tops of the tallest piers. A Universal truck crane gave useful service in stripping and carrying forms.

Personnel—The entire bridge project is under the control of the Triborough Bridge Authority, O. H. Amman, chief engineer, and H. W. Hudson, construction engineer. James H. Curtin, resident engineer, was in charge of work on the Queens approach. All current work on the project is financed by loans and grants from the Federal Emergency Administration of Public Works. R. A. Molstad acted as resident engineer for the PWA on the Queens approach.

For Rodgers & Hagerty, Inc., the contractor, John J. Hagerty, president, personally directed operations. F. W. Allen, chief engineer, was in charge of the preparation of progress charts, form design and all engineering activities for the contractor, assisted by William Kauffman and David Bonner.



SYSTEMATIC PROGRAM for re-use of pier shaft and cap forms, indicated in part by this portion of large drawing, simplifies and expedites handling of forms in field, with accompanying saving in time and money. Three sets of form g, for example, are used repeatedly, with minor alteration, on piers 1 to 4, inclusive. Figures given on drawing aid making and checking of forms and estimates. To left of three-column bent is given height in feet of each lift; at base of each lift is shown diameter in feet between flat faces of octagonal shaft. To right of center column is indicated cubic yards of concrete and square feet of forms for corresponding lift of one column. Similar quantities are given for cap beam and parapet.





Preliminary Construction Advances at GRAND COULEE DAM

INCE a general contract amounting to \$29,339,301 was awarded last summer for constructing the first stage of the Grand Coulee power and irrigation dam on the Columbia River, about 85 mi. west of Spokane, Wash., the Mason - Walsh - Atkinson -Kier Co., contractor, has made rapid progress on a variety of large-scale operations preliminary to the actual placing of concrete in the main body of the huge, straight gravity-type structure which will have an ultimate height of about 475 ft. above the lowest point of its foundation and a crest length of about 4,000 ft., including an 1,800-ft. spillway. As revised in an order signed June 7 by Secretary of the Interior Ickes, the latest plans for the project, financed by a \$63,000,000 PWA allotment, call for constructing the full section of the dam up to a height of 177 ft., leaving to a later date the continuation of the structure to its final crest elevation. This change supersedes the original projects for stage construction in the form, first, of a "low" dam and, second, a "high" dam.

An indication of the size of the preliminary construction operations is conveyed by these items: 'An estimated total quantity of about 17,000,000 cu. yd. of earth excavation (at \$1 per cubic yard) overlying bedrock at the dam



MASON CITY (in foreground) houses 2,100 members of contractor's personnel. Across river, above contractor's bridge, is government settlement and, in upper center of view, 3,000-ft. long west cofferdam of steel sheetpiling.

site; a belt conveyor system more than a mile long for removing the excavated material to spoil banks; three cofferdams and river diversion works involving a lump sum bid price of \$3,500,000; 3,100,000 cu.yd. of concrete in the dam to be built under the present contract (at \$3 per cubic yard), in addition to 400,000 cu.yd. of concrete in spillway and gravity walls, at \$4.50 per cubic yard. In the first of the three cofferdams, extending a distance of 3,000 ft. along the west bank of the

Columbia River (the river flows north at the dam site), a total of 667,000 lin.ft. of steel sheet piling, in lengths of 40 and 80 ft., has been driven with a battery of 30 steam hammers.

Construction Plant - For building the Grand Coulee dam the contractor is following a plan (see accompanying sketch) of unwatering the two shore ends of the structure behind cofferdams (one along each side of the Columbia River) within which excavation is carried down to bedrock, leaving the

river channel for final closure. The 3,000-ft. long west cofferdam, the first to be built was completed this spring. The east cofferdam, to be built this winter, will have a river wall parallel to and 708 ft. distant from the river wall of the west cofferdam, thus leaving an open river channel for flood flow of the Columbia. Probably during the winter of 1936-37 stream flow is to be diverted from this central channel and passed over foundation concrete near the west end of the dam. The river channel then is to be unwatered within a third, or central, cofferdam, excavated to bedrock and the central portion of the dam concreted.

Since the contractors were given formal notice to proceed on Sept. 25, 1934, progress has included much more than work on the dam site itself. The Columbia had to be bridged, first with a temporary pile trestle bridge and then with a permanent construction bridge; a water supply had to be developed; a city built; a construction program planned and plant assembled. Much of the work was done on rush schedule, as in the building of a 110,000-volt transmission line 31 mi. long in 42 days. Much of the work, too, had to be done under difficulties + cofferdam construction during subzero weather, and truck haulage over a 32-mi. route, pending completion of a railroad line from Coulee City.

On the west bank, a short way downstream from the dam site, a group of permanent buildings is under construction for the use of government employees of the U. S. Bureau of Reclamation. This settlement is known officially as Coulee Dam. On the opposite side of the river is the domain of the contractor, Mason City. Here has been created a settlement to house 2,100 people, with bank, post-office, city hall, large general store, theatre, hospital, churches, ball park, airport and other elements of modern community life. Unlike most cities, however, every house is occupied and there is a waiting list of would-be tenants. No chimneys are needed because all cooking and heating is done by electricity.

The water supply, taken from the Columbia River above the dam, is chlorinated and pumped to tanks on the hill above the town. Sewage is treated in an Imhoff tank with a 600,000-g.p.d. capacity and the effluent is discharged into the Columbia below the city.

In the married quarters at Mason City there are three classes of houses, all on 60x80-ft. lots with a four-compartment garage to every four houses. The rentals range from \$18 to \$38 per month, including water. Electrical energy is metered and householders pay at a low rate. Space for 1,200 men is provided in electrically heated cabins of twelve rooms in which each room has beds for two men, and in eight-room cabins provided with bath and toilet facilities. Bath houses are centrally located in each group of cabins. Tent platforms for



eight additional housing units provide emergency capacity.

Bridging the Columbia — The government's permanent bridge, located about ½-mi. below the damsite, will be a steel cantilever structure with a central span of 550 ft. Difficulties attendant upon getting the piers down to bedrock delayed the bridge contract for

several months. Pneumatic caissons finally were used and the piers are practically complete.

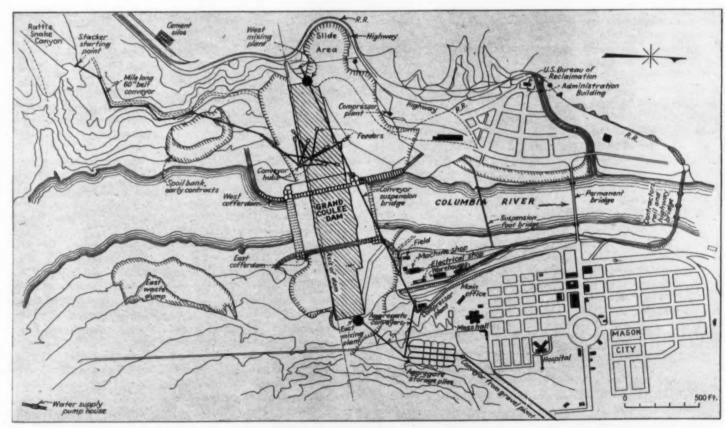
Meantime the M.W.A.K. company has built a 672-ft. temporary trestle and a construction bridge. The contractor's combination railway and highway bridge was opened for traffic March 31, and the trestle was removed a short

time thereafter, in advance of high water. When an ice jam threatened the trestle, construction of a light foot bridge—a catwalk suspension bridge with a 770-ft. span—was begun immediately and was put in service within four days.

The bridge on which the contractor has placed most dependence is a timber structure 30 ft. wide, which spans the river with four Howe deck trusses each 152 ft. long, supported by three channel piers of steel sheetpiling cells filled with gravel and with interior H-beam bearing piles capped with 5 ft. of concrete at the ice line.

Steel sheetpiling for the west cofferdam (which will be described in a subsequent article) constituted the heaviest tonnage during the earlier months of the job; fortunately it did not have to cross the river but was delivered on the west bank, which is the terminus of the 32-mi. road from the railroad at Coulee City. During the winter and early spring 18,000 tons of steel sheetpiling was trucked from the railroad for use in cofferdam construction.

The Slide Problem—Slopes as flat as 1 on 2 are found not to be stable in some parts of the area west of the damsite where slides have occurred. As it is through these areas that railway and highway communication with the job must be maintained, attention has been concentrated on stabilizing these slopes. Half a dozen drainage wells that were put down in the slide area were carried away by slides. Then a system was laid out depending upon shafts and drainage tunnels in rock which drained the lower portions of the drainage wells.



CONSTRUCTION PLANT LAYOUT for Grand Coulee dam, showing locations of three cofferdams and belt conveyor system for removal of excavation to spoil bank.

The major slide which occurred Nov. 15, 1934 is estimated to have moved more than 2,000,000 cu.yd. Several contracts have been let on slide removal at prices ranging from 43 down to 26c. per cu.yd.

Excavation at Damsite—Excavation on the east end of the dam site under a subcontract began Feb. 21, 1935 with two 2-cu.yd. and one 1½-cu.yd. power shovels serving 24 motor trucks. Pending construction of the east cofferdam this fall protection has been afforded by a wide dike of material left in place immediately along the river bank. Originally a belt-conveyor system was planned for use on this end of the dam, similar to the long conveyor now employed on the west end. On the east



WEST COFFERDAM'S upstream end. Feeder end of covered belt conveyor line is in lower left corner. Across Columbia River excavation in east cofferdam area is in progress. Mason City in upper left back-

CONTRACTOR'S BRIDGE across Columbia below dam site, built in 14 days, consists of four 152-ft. Howe timber deck trusses carried by channel piers of sheetpile cells filled with gravel. river. Cement blending will be done on the west side of the river just as the aggregates will be prepared on the east side. A suspension bridge will connect the two mixing plants; over the bridge aggregate will move westward on a conveyor and bulk cement will move eastward in a pipe.

The concreting plant as a whole is being laid out with the care warranted by an order for placing 3,500,000 cu. yd. If the present contract is supplemented by another providing for extending the height of the dam, the concrete total will be 11,200,000 cu.yd.

Specifications call for four sizes of gravel with 6 in. as the maximum, Sand will be graded by classifiers into three sizes later to be blended through proportional feeders and mixers.



SHUTTLE CONVEYOR, with 200ft. delivery arm, helps fill sheetpile cells of cofferdam with earth.

WEST BANK of river where slides of material hindered progress on excavation for dam abutment.

end, however, because of the short haul and the ease with which a truck road could be built, the conveyor belt idea was abandoned. Instead a 30-ft. roadway was located on a uniform 5-per cent grade and surfaced with about 18 in. of gravel. Over this roadway for several months a fleet of trucks has been hauling material from the excavation about 4,500 ft. upstream to the spoil bank. Excavation by this means averages about 10,000 cu.yd. per day.

On the west side of the river excavation began under the M.W.A.K. contract on Oct. 4 using 1½- and 2-cu.yd. shovels loading 8- and 12-cu.yd. dump trucks. Pending installation of the belt conveyor system the trucks hauled to temporary dumps in and adjacent to the government townsite.

Construction of the west cofferdam was rushed to completion before the season when the Columbia River usually is in flood; sometimes high water begins early in April. Despite difficulties of extremely hard bottom and cold weather, remarkable speed was made in driving 667,000 lin.ft. of steel sheetpiling used in the west cofferdam and it was completed early in April. Since Dec. 17 last year excavation has been removed from within the cofferdam area by the conveyor belt system.

Power shovels, dump trucks, tractor wagons and conveyor systems will be primary factors in excavation throughout the job. Despite the fact that the belt will be used for the long haul (possibly from the central and east cofferdams as well as from the one on the west side) shovels, dump wagons and trucks always will be depended upon for actual excavation and delivery to the belt.

Seven-hour Shifts—A notable feature of the work under the M.W.A.K. contract is the 21-hr.day consisting of three 7-hr. shifts. This has several advantages. Three, as cited by the contractor, are: (1) The interim makes it possible to familiarize the foreman of the oncoming shift with whatever conditions have developed during the preceding shift. In this time the two foremen go over the work together and develop any ideas they may have for

improving methods or speed. (2) Opportunity is afforded all operators of machinery to oil and inspect working parts and to do such maintenance or minor repair work as will be sure to keep the equipment in working order. Finally, in any emergency the entire crew can be kept at work during this additional hour without any claim for overtime and without exceeding the labor limit stipulations on a PWA job.

Aggregate and Cement Handling—Although the first concrete is not scheduled to be placed until October, much work has been done in planning and laying out construction equipment for getting out concrete aggregate, handling bulk cement and mixing and delivering concrete. Mixer plants, each with four 4-cu.yd. mixers, will be installed in duplicate on each side of the

The screening and washing plant is designed for a capacity of 1,000 tons per hour. At continuous, maxium capacity, the combined delivery from the two concrete mixing plants is to be 640 cu. yd. of mixed concrete per hour.

Personnel—The Grand Coulee project is being built by the U. S. Bureau of Reclamation, Dr. Elwood Mead, commissioner; R. F. Walter, chief engineer. F. A. Banks is project engineer and is assisted by James H. Miner, office engineer, and Allan F. Darland, field engineer.

The general contract for the Grand Coulee low dam which was awarded on a bid of \$29,339,300, is held by the M.W.A.K. company, formed for the purpose of bidding this job by Silas Mason Co., Inc., New York; Walsh Construction Co., Davenport, Iowa; and Atkinson-Kier Co., San Francisco. Officials of the M.W.A.K. Co. are Silas B. Mason, chairman of the board, T. J. Walsh, president; Guy F. Atkinson and M. J. Whitson, vice-presidents, W. A. Hanger, treasurer, and E. L. Kier, secretary. H. L. Myer is general manager, Francis Donaldson is chief engineer and M. H. Slocum is general superintendent.

SUBSEQUENT ARTICLES will describe cofferdam construction and the belt conveyor system for handling spoil at Grand Coulee dam.

HAMMERHEAD CRANES

Erect Batter-leg Bay Bridge Towers

OR ERECTING the four tall cellular steel batter-leg towers of the West Bay crossing of the San Francisco-Oakland Bay bridge, which rise to heights of about 500 ft, above mean low water level, hammerhead derricks on masts 108 ft. long, supported within 7x8-ft. open wells which extend through the cruciform cross-section of each inclined leg, were employed instead of the creeper travelers ordinarily used for an operation of this sort. On two of the four towers it is estimated that the use of the hammerhead derricks, "jumped" in 50-ft. lifts within the tower legs as work progressed, cut in half the erection time that would have been required with the conventional creeper travelers moved up on the outside surface of the towers.

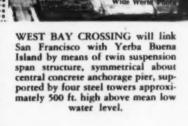
The west crossing of the Bay bridge, between San Francisco and Yerba Buena island, is a twin suspension structure, symmetrical about a central anchorage pier. Each half of the bridge is supported by two tall steel batter-leg towers on deep concrete caisson piers. Each pair of towers carries a main cable suspension span of 2,310 ft. and side spans of 1,160 ft. (except at the San Francisco end, where the length of the side span is 1,171 ft.). Two of the towers (Nos. 3 and 5) are 4621/2 ft. high above the tops of their supporting masonry piers, the latter extending about 40 ft. above mean low water level in the bay; the other two towers (Nos. 2 and 6) are each 4181/2 ft. from pier top to center of suspension cable. As indicated in the cross-section drawing, each tower leg is formed by four builtup cellular steel members grouped around the sides of a 7x8-ft, central well. Near the tower base there are a maximum of 21 cells in the section and at the tower top a minimum of 9 cells.

Two features of the tower-leg design influenced the selection of the hammerhead type of derrick for the steel section. (1) As indicated in the accompanying drawing, each tall steel leg has a cellular section in the form of a cross, with a 7x8-ft. open well at the

center. This well, it was realized, offered an ideal means of stepping and supporting the mast of a hammerhead derrick and raising it as steel erection was carried upward. (2) The fact that the tower legs are inclined, rather than vertical, would have added complications to the operation of creeper travelers moving up on the exterior surfaces of the steel members. The inclination of the tower legs, (spaced 83 ft. apart at the base and 66 ft. apart at the top) had, of course, to be taken into consideration in developing the working plans



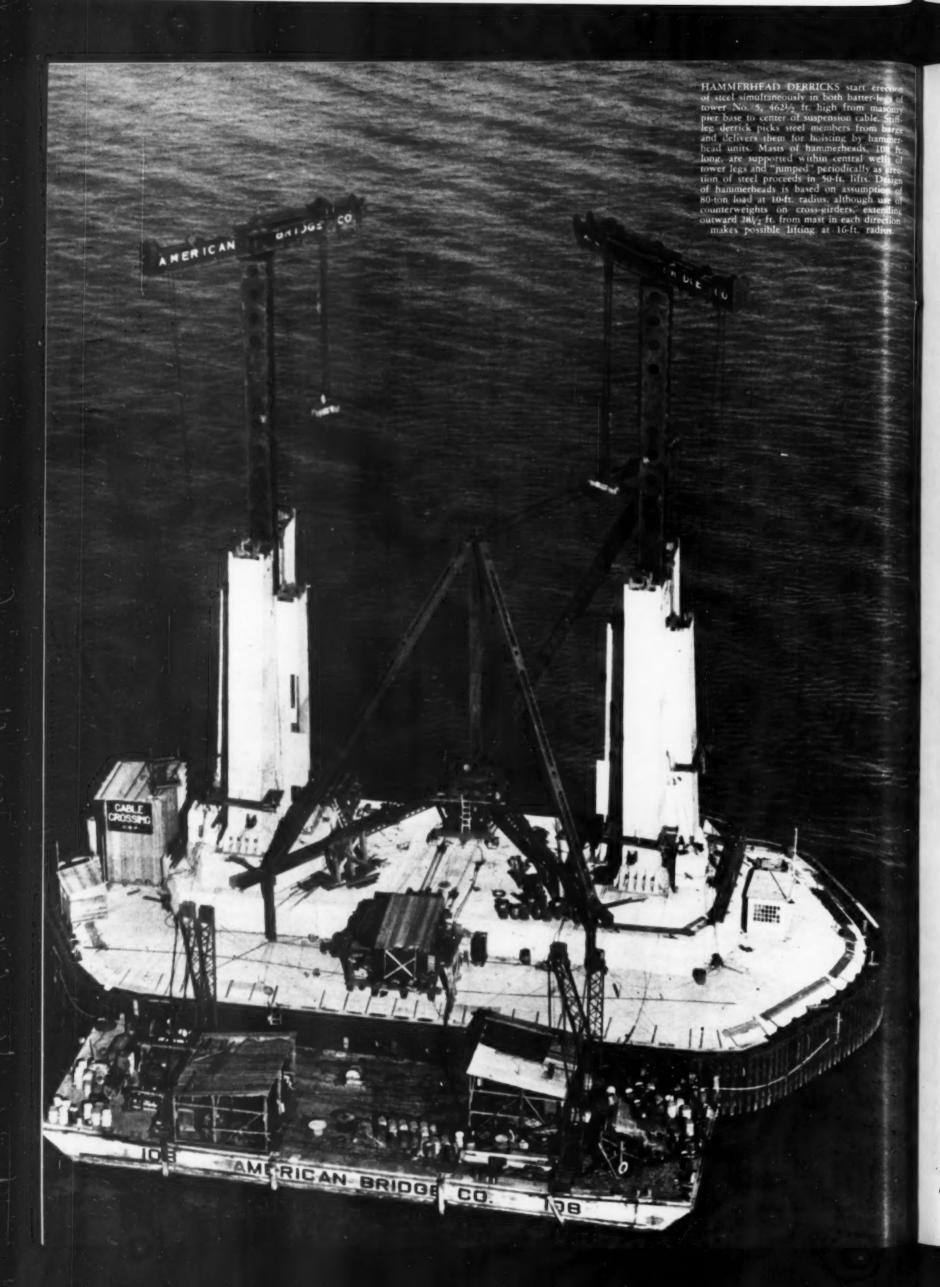
START OF TOWER ERECTION. Hammerhead derrick with 108-ft. mast for steel erection is being set up within the 7x8-ft. central well of one of the tower legs. Stiff-leg derrick helps erect hammerhead and feeds it with steel delivered by barge to tower pier.

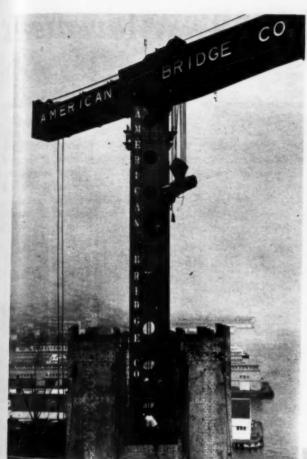


for the mast-supported hammerhead derricks and in order that the derrickmast within the inclined well of the tower leg might be plumb at all times the mast was bevelled on one side near its bottom.

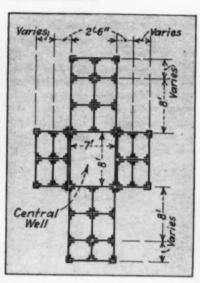
Steel arrived on the job ready for erection and field riveting in built-up lengths of 50 ft. The hammerhead derrick in each tower leg placed one of these cellular members on each of the four sides of the 7x8-ft. central well, thus erecting the tall structure in 50-ft. lifts. The heaviest single piece hoisted weighed 781/2 tons, picked up, with the aid of a counterweight, at a radius of 16 ft. from the center of the well. Nor--mally, however, a 10-ft. radius of rotation was sufficient for clearance in the operation of placing any part of the tower leg and the derrick design was based on the assumption of an 80-ton load at a 10-ft, radius.

The hammerhead mast, 108 ft. long, is 5x5 ft. in section, made up of $\frac{3}{8}$ -in. steel plates with $4x4x\frac{1}{2}$ -in. angles at

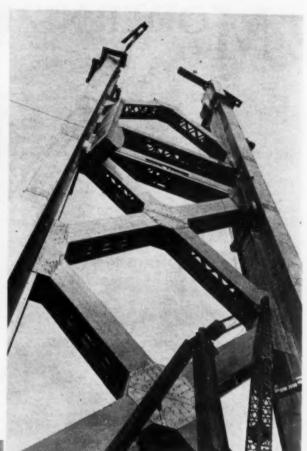




the base of the tower. For handling lighter loads at high speeds (up to 800 ft. per minute) the hammerhead was equipped with a pair of auxiliary falls with small sheaves.



CRUCIFORM SECTION of tower leg provides 7x8-ft. central well (in which hammerhead mast is carried) inclosed by four built-up cellular steel members.



GOING UP. Steel tower legs, with hammerhead derricks in their tops. have been braced by diagonal members and horizontal struts.

the corners. At its bottom are attached two girders to span the 8-ft. dimension of the well in the tower leg and rest on brackets bolted to its inside walls. The mast was equipped with screw jacks for purposes of plumbing and wedging it in place at the top of the well.

RAISING HAMMERHEAD derrick within central well of tower leg to new erection position after it has set steel for 50-ft. lift.

Inside the upper portion of the main mast was mounted on a step and ring bearing a 31/4-ft. square, 241/2-ft. long rotating mast to which were bolted the cross-arm or trolley girders of the derrick, extending outward 281/2 ft. in each direction from the mast. On tracks carried by the cross-girders a fourwheeled car operated; it had a shaft with six 20-in, ball-bearing sheaves, constituting the upper block of the main lifting falls. Rotation of the upper mast and cross-girder arms was by means of two motors driven by compressed air. When loads had to be handled on a 16-ft., instead of the normal 10-ft. radius, a counterweight, in the form of a 171/2-ton concrete block, was placed under the rear end of the hammerhead. Loads were never rotated, however, when the counterweight was in use; instead they were merely raised and drawn in to a 10-ft. radius, after which the counterweight was removed before rotation started.

The main lifting falls consisted of 10 parts of 1-in. wire rope passing through the sheaves of the trolley at the top and through a 5-sheave ball-bearing block at the bottom. The cable ends passed down through the mast and center well to a hoisting engine at



NEARLY COMPLETED. Tower No. 5, in foreground, reaches height of about 500 ft. above water level in bay. Hammerhead derrick in tower leg at right is in raised position for erecting guy derrick on horizontal top strut. Tower No. 6 and Yerba Buena Island in background.

Throughout erection of the steel tower legs the hammerhead derricks were served by a stiffleg derrick with 85-ft. boom which lifted steel from barges alongside the tower piers, raised the sections to a vertical position and set them up within convenient reach of the falls from the hammerhead. The largest, though not the heaviest, section handled was the horizontal bottom strut, approximately the size of a Pullman cat.

When a 50-ft, lift of steel had been erected the hammerhead derrick was raised to its new erection position by jumping falls on either side of the mast. Rollers and runners, placed where the mast would bear against the sides of the tower leg well, facilitated its movement during hoisting. After each 50-ft. tower height had been erected by the placement of four cellular steel sections around the sides of the central well, bracing was put in and enough bolts inserted to hold the assembly in place until the members were riveted. As the hammerhead was raised its supporting grillage and brackets were removed and replaced at the new level 50 ft. above the old one

The Columbia Steel Co. has the contract for the entire Bay bridge super-structure; fabrication and erection are by the American Bridge Co. under the direction of C. S. Garner, general manager of erection, and H. C. Hunter, western division erection manager. Both companies are subsidiaries of the U. S. Steel Corp.

"MODERNIZE FOR PROFIT" Movement

POR CONTRACTORS and engineers new and larger opportunities for participating in benefits from the "Modernize-for-Profit" movement, sponsored by the Federal Housing Administration, have been presented by recent amendments (approved May 28) to the National Housing Act extending the modernization credit plan to cover industrial and commercial loans up to \$50,000, as com-

pared with the former limit of \$2,000. This new type of credit, instead of being restricted to use for minor improvements of individual homes, is now extended to cover additions, alterations, repairs and improvement for "real property improved by or to be converted into apartment or multiple-family homes, hotels, office, business or other commercial buildings, hospitals,

colleges, schools or manufacturing or industrial plants."

The cost of architectural and engineering services is now eligible for modernization credit, as is also the purchase and installation of machinery and equipment in the types of property mentioned in the preceding paragraph, provided the equipment is "peculiarly adapted to the business conducted

therein or necessary to the operation thereof."

The new credit regulations invite contractors to sell their services locally for building-modernization projects of the type illustrated in the accompanying "before - and - after" photographs. Loans may be arranged through local banks that have qualified to receive FHA insurance against loss up to 20 per cent of the total sum lent.



Business building undergoes changes. An old fashioned fourstory masonry wallbearing structure, with concrete floors and structural steel interior frame, is modernized by a structural "facelifting" operation, utilizing concrete facade of vertical panels.



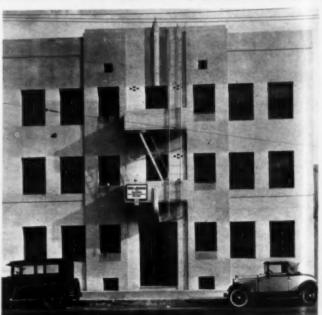


Here is an old, unattractive wooden dwelling in Palos Park, Ill., which was converted into what appears to be a modern villa by altering the design, adding a new wing and applying a cement stucco finish to the exterior.





Modernization converted the exterior of this outmoded three-story apartment building into an up-to-date structure with increased rent-producing possibilities. The remodeling was done by De Huff & Woodyard, Inc., builders, of Los Angeles, Calif.



August, 1935—CONSTRUCTION METHODS

Includes Building Projects Both Large and Small

noin

cally s of

phs. local ceive Vacant store space on ground floor of old Boston building is remodelled into six new shop units. Alterations involving use of stainless steel and other modern materials for new show windows were completed at cost of \$8,000.



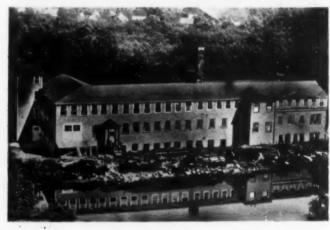


Cement played the leading roll in converting this eyesore on the corner of a business block into an attractive commercial structure, up to date in appearance and layout.





New England shoe factory building is rehabilitated by complete installation of new siding in form of lockbutt shingles.





CONSTRUCTION METHODS—August, 1935

ODS

Gingerbread exterior of old brick business building is superseded by concrete in redesign to modernize structure.

Contractors:

There are jobs of this type to be done in your locality if you will sell to owners the idea of modernization and your services for handling it.



Page 37



LOW COMPRESSION OF A-C OIL ENGINE CONTROLS CRANKSHAFT "WHIP"

"SHE purrs along like a gasoline engine." That's the way an operator describes the smooth flow of power which puts Allis-Chalmers Oil Tractors in a class by themselves. Yet... the A-C Oil Tractor operates on any low cost fuel that can be used successfully in a Diesel engine. Why this unusual smoothness? Because the Allis-Chalmers Oil Engine is not compelled to labor against high compression pressures... internal pressures are only one-fourth to one-third those of the unimproved type. Crankshaft "whip" is greatly reduced... the flow of power

through clutch, gears, shafts, etc., is far smoother. There is less strain on working parts, less vibration, fewer repairs. Power is more responsive ... the Oil Tractor "gets there" faster ... delivers more dirt to the dump ... at lower cost per yard. Get the FACTS about this new, improved system of engine operation ... Diesel fuel is injected with a Diesel pump and ignited with a spark. Here is one big reason why A-C Oil Tractors do the work at Lowest Final Cost.

ALLIS-CHALMERS



"I'll say it's easier to start," says the operator, "and we don't have to warm up the engine to burn Diesel fuel."

"Smoother operation and less vibration mean a lot to us. The 'LO' Oil Tractor goes where we want it ... right now."

"Simplicity of the Oil Tractor engine makes a hit with us. We don't need a service man around to keep it running."

Gives you: EASIER STARTING SMOOTHER OPERATION LESS VIBRATION FEWER REPAIRS

IGNITED WITH A-SPARK

INJECTED WITH ADIESEL PUMP

ther.

ibra ve ...

vers

ard.

ved

s in-

th a

Oil

Cost.

RAVELING bituminous mixing plants which picked up aggregates from a center-line windrow at the front of the machine and deposited mixed material at the rear last summer built two Wisconsin pavements of different types for the State Highway Commission on projects totalling 27 mi. in length. On one project, calling for a single course of asphaltic concrete with a minimum depth of 3 in., the Eau Claire Sand & Gravel Co., of Eau Claire, Wis., used a Cedar Rapids traveling bituminous plant to produce and discharge the asphaltic mixture in a con-





TRAVELING BITUMINOUS MIXER picks up graded aggregate to be mixed with hot asphalt for base course. Windrow of mixed material is behind machine.

tinuous operation. On a second project involving the construction of a high-type three-course bituminous pavement, Payne & Dolan of Wisconsin, Inc., with headquarters in Milwaukee, mixed two of the courses with a K&R traveling plant using hot asphalt and laid a wearing cours of premixed cold asphaltic concrete with an Adnun paver.

Three-Course Pavement - A 15.84 mi. section of state route 13 between Wisconsin Rapids and Friendship was paved by Payne & Dolan of Wisconsin, Inc., with a three-course bituminous roadway on a light existing base supported by a fine sand subsoil. The existing road had been graded 30 ft. wide and built up to 20 ft. width through a period of 9 years with clay, oil waterproofing, pea gravel, and crushed quartzite, applied in that order. Borings in 1933 revealed that the existing depth of base (gravel) averaged 11/2 in. over the entire job. This depth was computed on the basis of 2 in. of clay being equivalent to 1 in. of gravel. A tentative design for the new pavement was made by the State Highway Department and was modified as the work progressed.

A prime coat of tar, for example, was to be applied at the rate of ½ gal. per square yard in a width of 24 ft. The coat actually applied amounted to 0.37 gal. per square yard, as the quantity set up in the design proved insufficient.

TRAVELING Mixing Plants Build Bituminous Concrete Pavements

Leveling Course—A base of graded aggregate mixed with asphalt was called for in the original design to be placed on the prime coat 22 ft. wide and 1½ in. thick. Because of the weak and uneven condition of the existing base, the depth of this leveling course was increased during construction to 2 in. The aggregate was crushed gravel graded from 1½-in. maximum to a tolerance of 15 per cent passing a No. 10 screen.

Traveling Mixer—Aggregate for the leveling course was placed in a windrow along the center line of the road, from which it was picked up by a K&R crawler - mounted bituminous mixer manufactured by the F. T. Kern Co., of Milwaukee A bucket elevator carried the material from the windrow to a storage bin. From this bin, the aggregate discharged on a belt conveyor equipped with a poidometer for accurately weighing the material. The belt

conveyor delivered to a second bucket elevator which deposited the aggregate in a twin-shaft pug mill. Asphalt was delivered to the mixer by tank truck and was stored in an 800-gal, tank from which it passed through an accurate meter and heating coils to the pug mill.

Speed of the traveling plant was regulated in accordance with the size of the aggregate windrow in front of it. The plant proved an efficient unit, producing a uniform mix and enabling the engineers to reduce the quantity of asphalt in the leveling course to 3.2 per cent from the 6.2 per cent set by the design. After being deposited in a windrow by the mixer, the material was spread and leveled by means of motor graders and rolled with a 10-ton three-wheel roller.

Binder Course—On top of the base, the original design called for a binder course 2 in. thick and 21 in. wide made up of rock 100 per cent crushed rang-







BLACK-TOP PAVER, driven under own power, spreads, strikes off and partially rolls 1-in. wearing surface in half widths. Machine completes about 4,000 lin.ft. of 20-ft. surface each day.

ing from 2½ in. to ¾ in. mixed with asphalt in a ratio to be determined by the engineer. During construction, the depth of the binder was increased to about 3 in. The traveling plant mixed the material, which had an average bituminous content of 3.0 per cent. A Heltzel bituminous spreader drawn by the mixet distributed and struck off the mixture.

After a few minor adjustments had been made in the spreader, it proved greatly superior to the blade grader used on the leveling course, as it gave a reasonably smooth surface and a uniform crown. The discharge of the mixer had to be redesigned to deposit the material in two windrows, instead of one, to prevent segregation when being distributed and leveled with the spreader. After spreading, the binder course was compacted with the 10-ton three-wheel roller.

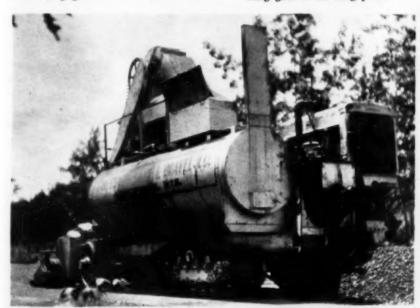
Following the rolling, the binder course was allowed to cure for a reasonable time before being covered at the rate of 56 lb. per square yard by a keystone or filler application of crushed stone chips ranging from 3/4 in. to 100 per cent retained on a No. 10 screen. The chips were broomed into the voids of the binder course and rolled with an 8-ton tandem roller before being given a tack coat of 0.18

ing from 2½ in. to ¾ in. mixed with asphalt in a ratio to be determined by the engineer. During construction, the

Top Course — A 1-in. compacted depth of wearing surface 20 ft. wide was constructed of cold asphaltic concrete premixed in Waukesha, Wis., and shipped to the job. An Adnun paver, moving under its own power, spread, struck off and partially rolled this material in half widths. End-dump trucks fed the asphaltic concrete to the paver while it was in motion. The machine



INCLOSED BUCKET ELEVATOR raises material from self-feeding device to hopper equipped with measuring gate on traveling plant.



TRAVELING BITUMINOUS PLANT of another type builds 3-in. surface mat to conserve gravel road.

proved to be fast and efficient, covering about 4,000 lin. ft. of 20-ft. road daily and striking off a much smoother surface than could have been obtained by the old hand-raking method. Both the 8-ton tandem and the 10-ton threewheel roller were used on the surface course.

Direction—Operations were conducted under the general supervision of W. J. Haselton, division engineer, Wisconsin Rapids, who supplied the data for the foregoing text. A. F. Ahearn, resident engineer, directed work on the project, and R. F. Stein, superintendent, was in charge of the job for Payne

Aggregate was shipped in by rail and trucked to the job, where it was placed in the center of the road and dried out with blades. After the material had dried, the blades windrowed it on the center line of the highway. A Cedar Rapids traveling mixer plant equipped with a self-feeding device picked up the aggregate from the windrow and conveyed it through a measuring gate into a pug mill. Asphalt (kept at 200 deg. F. in the storage tank) was applied as the aggregate was fed into the pug mill. The pug mill, of the continuous-operating type, discharged the material and deposited



MIXING PLANT picks up dried aggregate (shipped by rail to this locality) from windrow in center of road.

& Dolan of Wisconsin, Inc., contractors.

One Course Pavement-A bituminous mat having a minimum compacted depth of 3 in. was constructed by the Eau Claire Sand & Gavel Co. on an 11.4-mi, section of state route 13 between Washburn and Bayfield to conserve the gravel which had to be shipped into this locality for the resurfacing of the highway. The surface mat was placed on an existing gravel road which was wearing away in spite of treatment with road oil during previous years. Natural gravel deposits containing acceptable material in reasonable quantity do not exist in this territory, and road metal has to be imported at considerable expense.

A mat 20 ft. wide with 2-ft. featheredge sections at the two sides, making a total width of 24 ft., was called for by the design. The original grade was 30 ft. in width. Crushed sand-gravel of coarse-aggregate type and about 2.9 per cent asphalt were combined in the mixture. The aggregate gradation was from 1½ in. to 15-35 per cent passing a No. 10 screen.

Construction Procedure—In the first operation the existing gravel base was scarified and bladed into a uniform surface, with a small windrow left on each shoulder for later use. After the surface had been primed with 50-60 penetration asphalt at the rate of 0.5 gal. per square yard, the prime coat was covered by blading in these windrows. The base then was compacted by rolling.

it in a windrow behind the traveling plant.

Motor graders bladed the mixture from the center of the road into two equal windrows on the shoulders. These windrows later were spread back over the grade and bladed until the required final section was obtained. Rollers compacted the mat. Some hand trimming was necessary, especially on the feather edges.

A seal of 1/3 gal. of asphalt per square yard was applied to the surface and covered with concrete sand by hand at the rate of about 14 lb. per square yard. The pavement then was rolled again.

Progress—Work on the project was started June 5, 1934, and completed Sept. 26. Actual mixing was done between July 5 and Aug. 24. The maximum daily run for the mixing plant was 3,675 lin. ft. in a 12-hr. day. Seal coat was applied at an average rate of 1.7 mi. per day.

Personnel—G. I. Germond, division engineer, Superior, Wis., was in general charge of the work for the State Highway Department. Information for the notes on this job was supplied by S. W. Tuttle, assistant engineer of construction. Operations on the project were directed by L. L. McGauley, resident engineer.

A. O. Ayers, president of the Eau Claire Sand & Gravel Co., spent some time on the project in active charge of the work. Oscar Kittlestad and Carl Nystrom were superintendents.

Getting Down to DETAILS



TRAILER DISTRIBUTOR for bituminous road building, designed by Ralph Rogers Co., of Bloomington, Ind., and built in this contractors' shop, has 875-gal. tank mounted on Premier chassis manufactured in accordance with Rogers design. Unit is electrically welded throughout, is double-insulated and is equipped with LeRoi gasoline power plant. Double burners and double coils heat bituminous material. GMC trucktractor draws trailer. Double tachometer system aids accurate control of bituminous application at desired rate.

Close-up Shots of Job Methods and Equipment

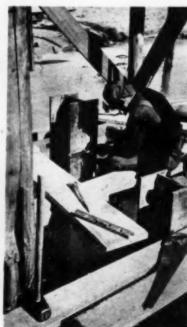


SPECIAL SKIP rigged on A-frame on rear end of truck is employed by crews of Tennessee Valley Authority for handling rock from quarry at Norris dam to crushing plant. Loaded skip slides up on angle-iron members of frame and is dumped by chains hooked to bottom of skip when latter is lowered.



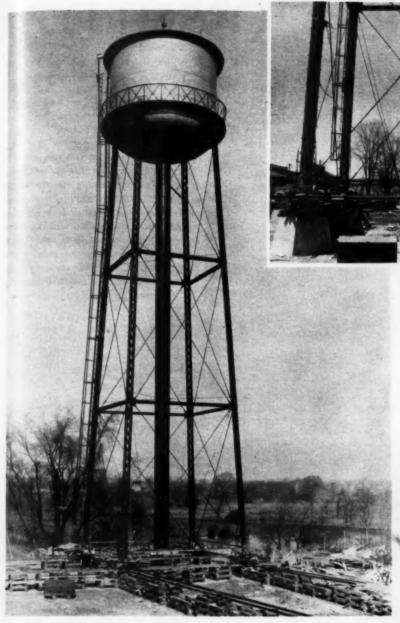
TIMBER TOWERS with steel beam caps are used to support, during erection, longitudinal steel girders of North Lawrence Ave. viaduct over Santa Fe Railroad tracks north of Wichita, Kan. Structure with 40-ft. roadway comprises continuous group of two 81-ft. and two 117-ft. built-up steel deck-girder spans with six lines of girders haunched over piers. Bridge was erected by C. E. Gray, contractor, of Emporia, from design prepared by La Matte Grover, bridge engineer of Kansas Highway Commission.

METAL STRAP (right), clamped in place, marks exact line for cutting off with oxyacetylene torch, prior to installing caps, steel piles driven approximately to grade on bridge project for Nebraska Department of Roads.



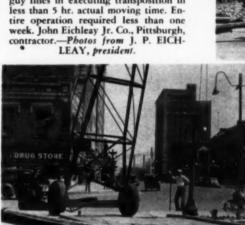


August, 1935—CONSTRUCTION METHODS



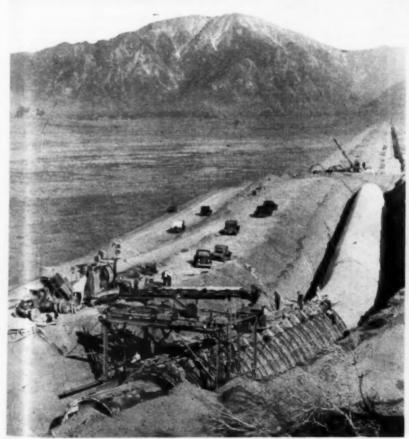


TESTED MOVING METHODS, utilizing steel rollers and crib-supported steel rails under four tower legs(above) transpose 50,000-gal. water tank (left) 125 ft. high, weighing about 40 tons, through moves of 150 ft. in two directions to new location for Pittsburgh Plate Glass Co. at Mt. Vernon, Ohio. Experienced structural movers use no guy lines in executing transposition in less than 5 hr. actual moving time. Entire operation required less than one week. John Eichleay Jr. Co., Pittsburgh, contractor.—Photos from J. P. EICH-LEAY, president.

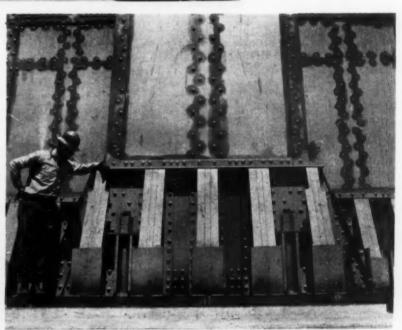




TWO - WHEELED CRANE (above and left) on pneumatic tires drops heavy metal "skullcracker" from height to break concrete pavement at abandoned service station in Peoria, Ill. Le Tourneau portable rig, operated by power unit on tractor, has overall height of 41½ ft., with 39 ft. available for lift. Outfit can be used also for pile-driving or steel erection.



CONSTRUCTION METHODS—August, 1935



CONCRETE DELIVERY (left) for open-cut section of Colorado River aqueduct in California is handled by Griffith Co., contractor, with belt conveyor fed by paving mixer operating alongside trench and discharging into moveable hopper above forms. Mount San Jacinto forms background for operations in Lakeview section of Metropolitan Water District.

WHERE STEEL AND CONCRETE MEET. Detail of foot of San Francisco-Oakland Bay bridge tower showing 4-in. thick steel base plate resting on concrete pier and 31/2-in. anchor bolts (60 per tower) set in the concrete. Base of tower measures 32x19 ft. and is fabricated of 11/g-in. steel plate. Each tower, about 500 ft. high, above water, requires 100,000 rivets.

REPAIR WORK RUSHED

in New York Flood-Damaged Area

By VINCENT B. SMITH

Associate Editor, Construction Methods

ROMPT ACTION and effective coordination of state and local agencies in the dozen New York counties disabled by the floods of July 7 and 8 quickly restored the damaged sections to a habitable condition by combating the danger of disease, opening principal highway routes to traffic and providing relief for the destitute. Within two days after the floods the stricken area was divided into three administrative districts by order of the Governor, with a coordinating board under an appointed chairman functioning at each of three points-Binghamton, Ithaca and Hornell. Represented on these boards

River was rising at the rate of 1 ft. every 20 min., and this condition was typical of other large streams in the flood area. During the night all efforts of the CCC boys, called out of their camps at 1 and 2 o'clock in the morning, and of local residents were concentrated on saving lives and moving people out of threatened structures. Continued wet weather for two days after

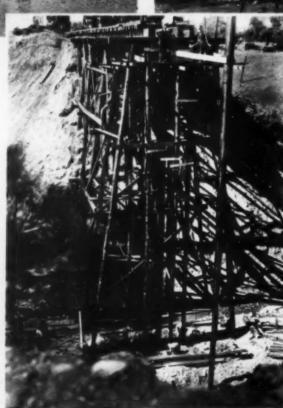
WOODEN FOUNDATION FORMS (left) in place to underpin end of eroded culvert on state route 41 north of Greene. Driver of automobile escaped when car dropped into hole at night during flood.



TRUCK CRANE aids construction of temporary timber trestle replacing steel and concrete bridge on route 12 north of Greene. Presence of steel girders and broken slab in stream bed makes piledriving difficult.

were the State Department of Health, the State Department of Public Works, the Temporary Emergency Relief Administration (the agency handling federal and state relief in New York State), the Civilian Conservation Corps (directed during the emergency by engineers of the State Conservation Department) and the Red Cross, in addition to local health and public works divisions. Meeting at night after the close of a long day in the field, these boards pooled reports of current needs and apportioned responsibility for taking care of them.

Quick runoff of a rainfall of varying intensity estimated to have equalled or exceeded 12 in, in 10 hr. in many places on the night of July 7 turned dry stream beds into raging torrents, washed thousands of cubic yards of gravel and boulders off the hills onto highways and private property and inundated valley towns and farms. At Binghamton, on the morning of July 8, the Chenango



TIMBER PILE TRESTLE requiring creosoted piles up to 90 ft. long replaces double-box concrete culvert and earth embankment across ravine on New York Central 2 mi. north of Watkins Glen.

CONDITION OF FARMHOUSE outside Smithville Flats after flood from hillside had passed. Deep deposits of boulders and gravel throughout flood area attest strength of torrents pouring down hillsides which are ordinarily dry.

> the cloudburst hampered relief activities, but local authorities and state engineers made surveys and estimates of relief and repair needs as rapidly as the waters receded. For the State Department of Public Works the first necessity was to open roads to towns and villages cut off by the floods.

Transportation Systems-A total of 86 bridges on the state highway system alone were swept away or badly damaged by the flood. As indicated by the photographs, a number of these bridges were modern in design, but most of them were older types taken over by the state with portions of the town road system. By means of temporary bypasses, utilizing fords or timber bridges, the state highway engineers managed to open at least one route into each locality within one to two days after the disaster. Over these temporary structures, the State Health Department, the TERA and the Red Cross transported medical supplies, food, clothing and bedding to

inhabitants of devastated villages and farms.

As soon as access roads had been opened to all points in the flood area, the district engineers of the State Department of Public Works concentrated effort on replacing structures and embankments on main thorough routes. These structures, of a temporary nature, utilized salvaged material from wrecked bridges where possible. Many temporary bridges were built on timber piles or cribbing, with steel or timber stringers and wood plank decking. Practically all available construction equipment in the flood area not engaged in cleaning up towns and villages was rented by the Highway Division to supplement its own mechanical resources in rushing work on temporary bridges, in stripping overburden and debris from roads and in rebuilding eroded embankments.

ft.

was

the

orts

heir

orn-

cen-

peo-

Con-

fter

Tivi-

en-

s of

s the

part-

ssity

ages

1 of

stem

lam-

the

dges

t of

r by

road

sses.

the

1 20

cali-

dis-

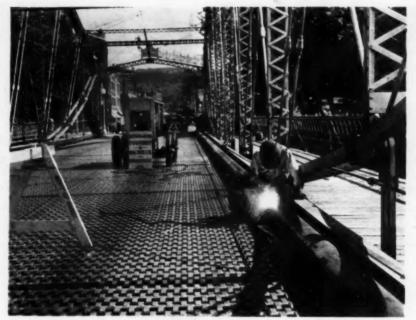
ures,

ERA

dical

g-to

DDS



the legs of the bents have been found as much as a mile downstream.

Water Supply—In Binghamton, the city lost four of its six water mains crossing the Chenango and Susquehanna Rivers. Valves in the broken mains were closed promptly, putting a total of about 1 mi. of the city's large supply mains out of service. Pressure in the remainder of the system was maintained by connecting Johnson City mains into the Binghamton lines. Temporary mains to replace the broken lines in the rivers were laid across city bridges.

Cleaning Up — Amazingly rapid strides were made in the prodigious task

WELDED STEEL WATER MAIN (left) installed across Washington St. bridge, Binghamton. Supply of 10-in. pipe obtained from local gas company takes place of nearby 12-in. main in Susquehanna River broken when flood in Chenango River backed water up this stream.





OVERTURNED ABUTMENT and displaced deck slab of reinforcedconcrete bridge on route 220 north of Smithville Flats.

Of five railroads in the area only one, the Lehigh Valley, escaped without serious damage. The New York Central, the D. L. & W. (Lackawanna), the Erie, and the Pennsylvania suffered washouts which interrupted service from a few days to more than a month. Replacement of bridges and culverts, rebuilding of long stretches of embankment and relaying and reballasting of track were necessary in many places. Timber cribbing was utilized where called for to support the tracks while rebuilding fill. In at least one instance temporary bridges incorporating salvaged girders were washed out by a minor flood one week after the major disaster because not sufficient time had intervened to permit digging new channels for streams which had filled their old beds and wandered off on new courses.

Reconstruction is in progress on what is probably the most seriously damaged railway structure in the area—the steelbent and concrete-pedestal double-track bridge at Watkins Glen on the Pennsylvania division of the New York Central. (See photo in "News Reel" section of this issue.) The flood in the Glen took out two bents supporting three spans, two 70 ft. long and one 30 ft. long. Towers of this bridge measure 165 ft. high from stream bed to base of rail. Twisted pieces of steel from



TEMPORARY MAIN of 12-in. cast-iron, bell-and-spigot pipe on Court St. bridge, Binghamton, replaces broken 12-in. main in Chenango River at this point.



WASHED-OUT APPROACH to new highway bridge which withstood force of flood at Smithville Flats on New York state route 41 north of Binghamton.

SETTLED ABUTMENT and eroded approach of new 34-ft. steel girder bridge across Geneganslet River on state route 220.

of cleaning up towns and villages. Thousands of TERA, CCC, and Transient Bureau workers, in addition to other thousands of local residents, American Legion members, and National Guardsmen, labored from dawn to dusk at removing gravel, mud, slime and debris from streets, cellars and lawns. Every available piece of pumping, excavating and trucking equipment was pressed into service.

Because of their excellent organization and equipment, the CCC camps in and near the flood area gave particularly effective aid in this work. Each camp, comprising about 150 men, had a working organization already in existence consisting of a work superintendent and from eight to seventeen gangs, each under its own foreman. The camps furthermore were equipped with tractors, bulldozers, trucks and tools which could be turned at once to the work of reconstruction. In some cases entire camps were moved to centers of devastation, where the boys bunked in tents. Working long hours and utilizing all the facilities of their exist ing organization and equipment, the corps gave splendid service in the emergency. In the Binghamton district, nine camps were engaged in the work, and corresponding numbers furnished aid in the other two districts.

JOB MANAGEMENT

IN ROAD BUILDING

Sixth of Six Articles Dealing With Factors That Affect Equipment Selection, Operation and Dependability, Production and Cost

-6-

Asphaltic Concrete Paving Operations

N GENERAL, the problems encountered in the management of asphaltic concrete pavement construction are similar to those encountered in the construction of portland cement concrete pavement. In both types of construction a rate of output must be set up as the basis on which to design the organization. In both types the subgrading and form-setting series of operations must be kept in step with paving operations. In asphalt paving work, however, there is a little more flexibility than on concrete work, as it is usually considered proper to keep a little more subgrade ahead. In addition to this, the subgrade itself is not, as a rule, as exactly prepared, with the result that the subgrading and form-setting operations do not as frequently obstruct paving opera-

Asphalt Plant—The asphalt plant is the key producer and any rate of production that is set for the job as a whole must, as a matter of course, take specification requirements as to mixing

By J. L. HARRISON

Senior Highway Engineer, U. S. Bureau of Public Roads, Washington, D. C.



MECHANICAL SCREED replaces hand raking in distributing and compacting asphalt mixture on half-width construction. Surface mixture in foreground, however, is part of intersection raked by hand.

time and other known factors into consideration. The job production rate having been established, the same precautions noted in the previous article for developing a well balanced portland cement concrete paving organization apply equally here. There are, however, some special factors which affect the production on asphalt jobs and these will be discussed in some detail.

In designating the asphalt plant as the key producer, the term "plant" implies that it is not a single machine but an assembly of more or less independently operated machines, and this is just what an asphalt plant really is. Obviously, then, if a given rate of output is to be supported by the asphalt plant it is essential that all of the machines which, taken together, comprise it must be capable of supporting this rate. It was a good deal of a surprise to the writer to find that relatively few asphalt plants, as assembled, meet this basic requirement. Inadequate dryer capacity is the defect most frequently encountered, but inadequate elevator ca-



HAND LABOR USED TO BE EMPLOYED almost universally for spreading and raking asphalt mixture. This practice necessitated employment of large crew of men.

pacity and inadequate storage capacity are also common.

"Dryer Capacity"-Inadequate dryer capacity is so commonly encountered that a little comment in regard to it seems desirable.' Asphaltic mixes of the various kinds which are produced as plant mixes are mixed hot and must be delivered at the point where they are to be used at temperatures which are a good deal above atmospheric temperature. To attain this result the temperature of the mineral aggregates used in such mixes must be initially raised to a point several hundred degrees above atmospheric temperature as, after heating, they must usually be screened and are always elevated into bins where they will remain for at least a brief period before mixing takes place. All of these operations dissipate heat.

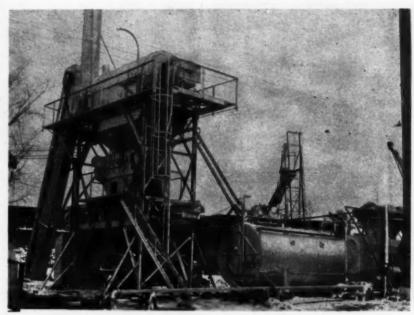
In addition to the heat used in raising the temperature of the mineral aggregate to a proper initial point, heat is required to drive off all of the moisture that may be attached to the aggregate. This moisture must be driven off as

V-

10

nis but

It he as-



MODERN PORTABLE ASPHALT PLANT of Madsen type is completely electrified. Features include inclosed elevator, internally fired elevated drum, mechanically fed batcher, steam-jacketed mixer and temperature indicating and recording devices.

as it always shortens the life of the dryer and seldom consistently produces the required amount of material.

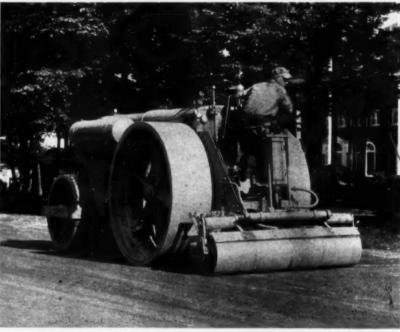
Dependability-As the asphalt plant is the key to production, dependability here is essential to the maintenance of a uniformly high rate of operationjust as essential as it is in the key producer used on any other type of construction work. Much ragged and unduly expensive production is traceable to the fact that the plant has been continued in use long after it has ceased to have a proper degree of dependability. Some allowance must, of course, be made for the fact that an asphalt plant is an expensive item of equipment. Some allowance must also be made for the fact that it is far more difficult to keep machines that are handling hot materials running smoothly than is the case with machines that are handling materials at air temperature. Still, even after making due allowance for these and other controlling factors, the fact remains that, very generally, insufficient attention is paid to plant conditions,



ROLLING EQUIPMENT is an important item on any asphalt paving job. On this job are two 10-ton gasoline tandem units and one three-wheel 12-ton Buffalo-Springfield roller.

steam and just here lies the difficulty. The specific heat of water is so high that a comparatively small amount of it, some 5 or 6 per cent by weight, is all that is required in order to produce a condition in which the heat required in drying the aggregates is as great as the heat required in raising the temperature of the aggregates. The inevitable result is that if the dryer is purchased on the assumption that air-dried materials are to be handled, the dryer will "bog down" after every rain which saturates the materials in storage or whenever materials as usually obtained carry a high moisture content.

The solution is, of course, the use of a dryer which is large enough to provide ample reserve capacity, a reserve capacity sufficient to enable it to handle the required amount of material even when weather or other conditions are adverse. The present practice of using extra heat in the dryer when wet material is being handled is objectionable



IRONER ROLL, in form of cylinder on rear end of this 10-ton Hercules roller, removes high spots and produces smooth surface.

with the result that high production is not as consistently attained as it could readily be and that costs are neither as low nor as well controlled as more attention to plant condition could readily make them.

On asphaltic concrete jobs the attainable rates of production are affected by the tooling of the hauling operation just as on portland cement concrete jobs and on grading jobs. For that reason, aside from observing that undertooling here is fatal to production schedules, no reference to hauling will be made, for the effect of undertooling the hauling operation has been presented in previous articles.

Mechanical Spreading—Until recently, spreading and raking the asphaltic mixes have been performed by hand. These operations now are quite often performed by spreader boxes and finishing machines. As in so many other operations, the mechanization of these operations creates a certain degree of de-





PENETRATING WORK shows same trend toward mechanization as does plant-mix type of construction. PRESSURE DISTRIBUTOR (left) applies hot asphalt while stone spreader (right) with fantail discharge puts down screenings.

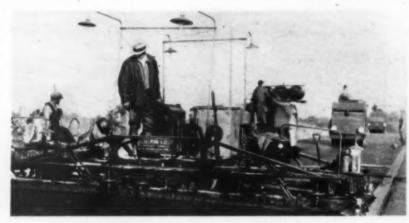
pendability which always is desirable and avoids the possibility that poor judgment as to the man power required in performing them will increase cost.

Rolling-Rolling is an important operation on work of this character. It is vital that this rolling be both adequately and properly done. As a result, specifications often prescribe rigid limits on the amount of work a roller can perform per hour. It is, of course, always necessary that this operation be adequately tooled. Usually a minimum of two rollers is required, but if a high rate of production is to be attempted, there are a good many places in which specification requirements will dictate the use of additional rollers. Unless these are furnished, the capacity of the rollers on the job, rather than plant capacity, will govern output. This is a condition no contractor can afford to permit long to maintain.

"Inadequate dryer capacity is the defect most frequently encountered in asphalt plants, but inadequate elevator capacity and inadequate storage capacity also are common."

Once a well balanced, properly tooled organization has been developed, production should run smoothly for the basic conditions from which production results have been developed. When the expected rate of production is not realized various things can be responsible and the organization as a whole, as well as the general conditions which surround the work, must be critically examined in an effort to ascertain the cause. When the cause is found, corrective action must be taken.

Correcting Operating Troubles—
There is a great deal of difference in the vigor with which different men hunt for the cause of unsatisfactory results and an equal difference in the vigor with which they drive for correction. A sin-



FINISHING MACHINE of Lakewood type replaces hand labor in spreading and screeding of asphalt mix. Note lights for night work.



BLACK TOP PAVER lays base course of bituminous pavement. Adnun unit, powered by gasoline engine, is fed with plant-mix material by motor truck, not shown in this view.

gle illustration will, perhaps, clarify the meaning of this observation. During a discussion of the production on a Western paving job the superintendent remarked to the writer that one reason production appeared low was that, for several days, the yield factor had been under 90, that is, less than 90 per cent of the proper yardage had been obtained from the batches mixed. He complained bitterly over the situation but admitted

having done nothing to correct it though it should have been evident that, in all probability, the subgrade was low. As far as the writer knows, this condition was allowed to continue until it corrected itself.

A month or two later the writer visited a Southern job and there saw the work closed down within 15 min. after the superintendent was informed that the yield factor on the previous day's

run had been 95 per cent; suspension of work continued until the subgrade planer and all of the templates had been checked and corrected. For the remainder of the day the yield factor exceeded 99 per cent. This vigor in looking for and correcting any condition which was found to be interfering with the attainment of proper operating results kept production on this job at a high level in spite of many adverse conditions. The application of this same sort of vigor to the detection and correction of undesirable conditions will go far toward insuring satisfactory results on any type of construction work.

Then, too, there is foresight, the ability to see things before they occur, often to prevent their occurring at all. A good many "bad days" can be avoided by looking ahead.

Foresight—On one occasion the writer observed, with much interest, that the grade stakes on an important paving

"Much ragged and unduly expensive production is traceable to the fact that the plant has continued in use after it has ceased to have a proper degree of dependability."

job indicated that within about four days the fine grading crew would strike into a 2,000-ft. stretch of roadway where, instead of the normal 3 to 4 in. of material to be handled, from 12 to 18 in, would have to be removed. The subgrading crew was nicely in balance with plant output because work for some time had involved normal subgrading quantities and was normally in advance of paving operations. On the fifth day the paving operations piled up on the subgrading crew and it was not until they did that it occurred to anyone connected with the job that a subgrading crew which could handle 4 in. of material efficiently could not handle from 12 to 18 in. Looking ahead for conditions which may cause trouble and

planning to meet them before they become a reality will save many a day during a normal construction season.

Weather Reports-Often the matters to be foreseen appear to be of little consequence but nevertheless attention to them may yield rather surprising results. The writer once knew a superinrendent who studied the weather reports every day. It is surprising how few of them do! Whenever a storm was approaching he knew about it and ran the blade grader over the road to fill holes and give it a little crown. He also opened drains at appropriate places under set forms to prevent water from collecting and standing there. As a result he saved several days time during the construction season by being able

"It is far more difficult to keep machines that are hardling hot materials running smoothly than is the case with machines that are handling materials at air temperature."

sion

ade

had

re-

ev.

nk.

vith re-

erse

ime

cor-

will

re-

ork.

bil-

ten

boo

rit-

hat

ike

to The need of

nd DS to get back to work more quickly when the storm was over. A small matter? Perhaps. But it is foresight in small matters as well as in large ones that in no small degree is responsible for keeping the well designed construction organization on the schedule it is physically capable of maintaining.

One further word as to foresight. There is, perhaps, no other field where more of it is required than in the materials delivery field. One cannot lay much asphalt pavement after the tank is empty. A brick pavement cannot proceed after the supply of brick is exhausted. Even the lack of a few pieces of reinforcing steel has been known to shut down a concrete paving job.

Materials Delivery—As a rule, materials commitments are made by the central office and when such commitments are made, tentative delivery schedules are indicated. Such schedules must necessarily give reasonable consideration to the interests of both produc-

ers and purchasers. Usually the interests of both are best served by what may be termed a normal delivery schedule, that is, one which presumes that deliveries will be made at about the rate at which the materials are to be used on the job. These schedules are not rigidly fixed, and in the nature of the case cannot be, but producers naturally desire to have them maintained as closely as possible. On the other hand, from the job standpoint, it would be preferable to have a day-to-day adjustment of rates of delivery, for by so do-

ments in delivery rates as job conditions thereafter require.

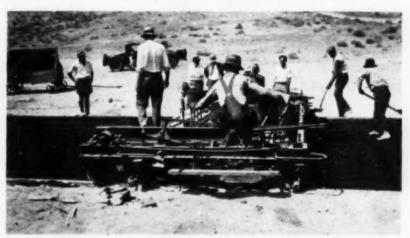
Stated in this rather general way, looking after the materials supply would not seem to offer many complexities, but this statement does not include any reference to the time lags which are involved. To maintain a materials supply on a large job materials in carload lots have to be kept rolling. At any particular time, in addition to

ing rehandling charges would be avoid-

ed. The usual solution is limited storage

at the materials vard with such adjust-

HAND LABOR and hand tools are still necessary for putting down patches in asphaltic pavement maintenance with material supplied by Austin-Western hot-patch outfit.



SIDE VIEW of mechanical finisher for asphaltic pavement construction, showing how self-powered unit rides on wheels along forms.

the materials on hand, some cars are en route and others are being loaded at the various plants serving the job. When a protracted storm shuts down the work for several days or a strike closes a source of supply or a wreck shuts off the ordinary route over which the materials supply moves, it becomes the duty of the superintendent, as it is under a thousand and one other circumstances, to take steps to keep the adverse affect on the job at a minimum. To reach this objective exact information is required but, besides this, it is necessary not only to think for today and tomorrow but perhaps also to think for next week as well, to decide what action is required and then vigorously to take it.

"Looking ahead for conditions which may cause trouble and planning to meet them before they become realities will save many a day during a normal construction season."

There can be no temporizing here! Without materials the job is dead. This is inevitable. Reviving it again after a shutdown always is expensive for it takes time to get even a well organized job to clicking after it has been stopped for a day or two. So the materials supply demands not only constant attention but also vigorous action and this attention always should be projected into the future. In short, today's materials supply always should be protected last week or the week before! If this is done as to the materials supply, and as to other job matters, and a properly equipped, well balanced organization is maintained, high production will be obtained and this at a proper cost.

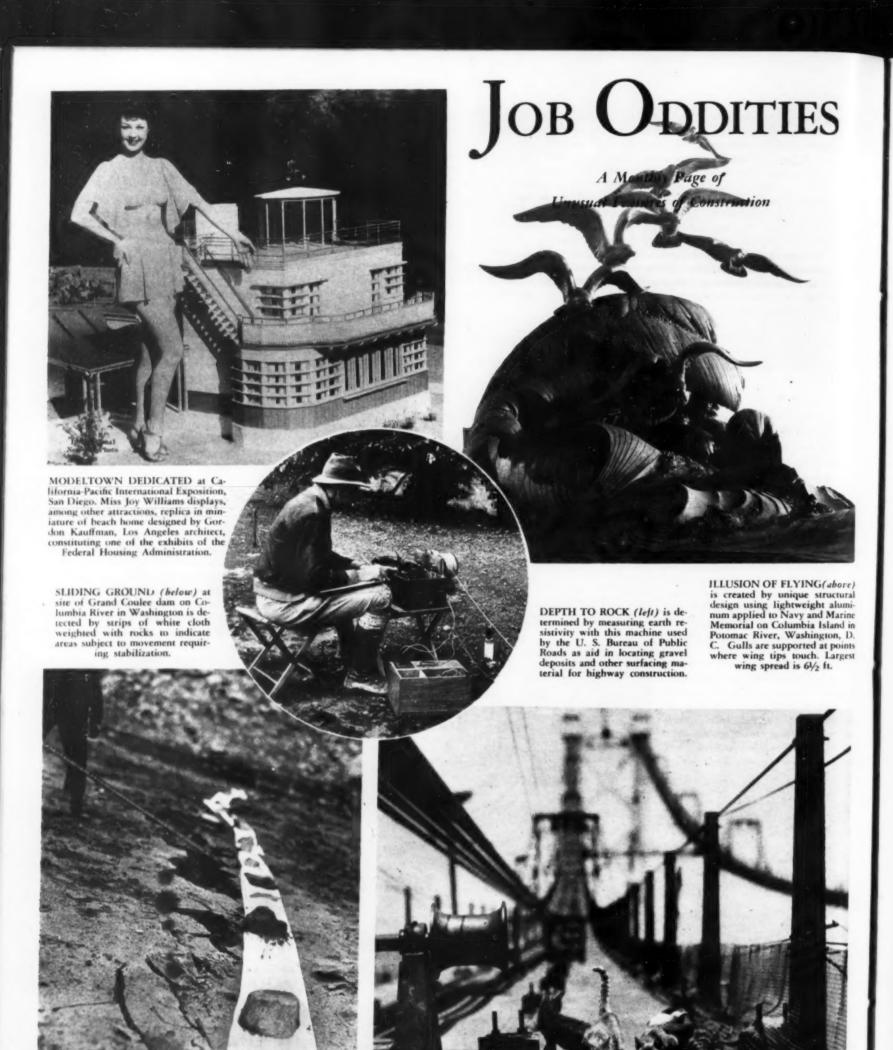
This is the last of six articles on "Job Management in Road Building" by Mr. Harrison. The first article was published in March and others have followed in succeeding issues.



MILE-A-DAY PROGRESS is achieved by this traveling bituminous road-mix plant operated by Clyde W. Wood, California contractor.



THREE-WHEELED ROLLER compacts screenings distributed by grader on armor-coat surfacing in California.



CATS ON CATWALK. Just to prove that there's something in a name after all, California kitties abandon back fences for promenade on wire-mesh aerial thoroughfare hung below suspension cables of San Francisco-Oakland Bay bridge.

Present and Occounted For -

A Page of Personalities



ore) tural

DS

HONORARY
DEGREES for
Boulder dam builders.
Walker R. Young (left),
construction engineer
for the U.S. Bureau of for the U. S. Bureau of Reclamation, and Frank T. Crowe (right), gen-eral superintendent for Six Companies Inc., have been made Doc-tors of Engineering re-spectively by the Uni-versity of Idaho and the University of Maine.



NATHAN L. SMITH (below) has been appointed chief engineer of the State Roads Commission of Maryland, which he had formerly served as chairman, succeeding H. D. Williar, Jr.

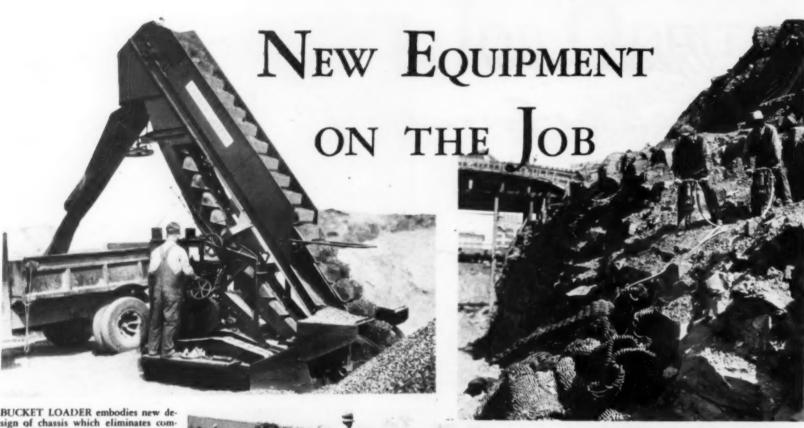


CHARLES F. GOODRICH (left), for-merly assistant chief engineer, has been promoted to chief engineer of the Amer-ican Bridge Co. to fill the vacancy cre-ated by the resignation of Richard Khuen after 41 years of service with the company. Mr. Goodrich has been with the American Bridge Co. in various engineering capacities for 29 years. His headquarters will be in Pittsburgh.

GEORGE A. MONTAGUE, assistant civil engineer in charge of construction for the Worcester District of the Massa-

chusetts Department of Public Works, is the new president of the Engineering Societies of New England, Inc.

CONSTRUCTION METHODS—August, 1935



BUCKET LOADER embodies new design of chassis which eliminates complicated channel and cross-bracing construction and ties main frame into compact, integral unit, increasing strength and accessibility and completely housing driving machinery. Other features: Special arrangement of spiral screws synchronizes feeding and increases capacity. Parallelogram axle and three-point suspension gives knee action and keeps crawlers parallel. Automatic release sprocket protects machine from overloads. Quick-acting, self-locking swivel spout; high-backed buckets; hard facing on bucket lips; slow crowding and fast traveling speeds. Clocked at 3 yd. in 45 sec.—Barber-Greene Co., Aurora, Ill.

BELT-CONVEYOR-TYPE TERRACER for arresting soil erosion consists of an extra heavy 26-in. revolving slow disk, mounted on roller bearings, which cuts into soil and elevates it upon a rubber-covered conveyor belt. From there earth is discharged at a distance of approximately 10½ ft. at right angles to furrow. Conveyor

THREE-SPEED ROCK HAMMER suitable for mine service, quarrying, road work, rock cuts, trench work, boulder popping, hand-line drilling and all general construction needs. Cleans holes to depth of 20 ft. Single, easily-operated throttle controls both drilling and blowing. Equipped with open-type, rubber-grip handle and inbuilt lubricator. Easy adjustment provided for three rotation speeds to accommodate varying degrees of hardness of rock. Units for either wet or dry drilling. Operates either from portable or stationary compressors. Chuck accommodating 1x4½-in. hexagon-collared steel usually furnished, but others may be ordered, if desired. Cylinder bore, 2½ in.; stroke, 2½ in.—Worthington Pump & Machinery Corp., Harrison, N. J.

belt is operated from power takeoff of tractor. Under normal soil conditions manufacturers claim unit with 15-30 tractor for power will build about one mile of terrace per 9-hr. day at cost of from \$13 to \$17 per mile. Terraces built by this machine are from 16 to 18 ft. wide at base, from 16 in. to 2 ft. high. Outstanding advantage of terracer is that there is no necessity of moving earth second time as conveyer places it exactly where wanted, eliminating need of working terrace or shifting it about. Single operator handles both tractor and terracing machine.—Standard Steel Works, North Kansas City, Mo.



REVERSIBLE WRENCH (left), of air-driven, impact type can be used equally well both for applying and for removing nuts. Reversing is accomplished by shifting gears rather than by operation of air motor, a method which results in economy of air consumption and greater safety in using wrench. Another feature is air cooling of accumulator which prevents overheating and results in longer life. Runs nuts on or off at speed of about 600 to 700 r.p.m. and 1,200 to 1,400 impacts per minute, tightening or loosening.—Ingersoll-Rand Co., Phillipsburg, N. J.

TRAILER for carrying excavator from job to job has front-axle steering, dual pneumatic front and rear tires and rear wheel brakes. Excavator is loaded in this way:

(1) Trailer front axle is disconnected; (2) trailer is reassembled and frame raised into position with built-in screw jack; (4) machine is fastened by clamping excavator axles to trailer frame. Overall height of mounted excavator is 10 ft. 8 in. and weight on each axle of trailer only 10,000 lb. Loaded trailer can be turned around in 50-ft. street without backing.—Bucyrus-Erie Co., South Milwaukee, Wis.

STEEL PILE SHELLS (Insert and right, below), cold rolled to give ultimate tensile strength and elastic limit and fluted to increase surface or skin frictional area, offer contractor-users following advantages: (1) Resist lateral forces caused by back pressure and tendency to collapse when adjacent piles are driven. (2) Eliminate need of internal reinforcing steel in concrete. (3) One-piece, joint-free construction makes them particularly suitable for pier and dock work. (4) Easy to handle and inspect. (5) Drive without core on mandrel. (6) Require no special or heavy driving equipment. (7) Shell is left in ground permanently. (8) One man with acetylene torch can make cutoff in less than 1 min.

—Union Metal Mfg. Co., Canton, Ohio.



FLOOR LATH (right) combines reinforcement and form for concrete floor and roof construction. Steeltex consists of 12-gage cold-drawn electrically welded galvanized steel wire in 3x4-in. mesh which is attached to tough corded backing (which acts as a form) by means of crimp wires. These crimps also space reinforcement at proper distance from backing so that concrete completely surrounds and embeds wires, saving labor of blocking up or pouring slab in two operations. Corded backing is of sufficient strength to support concrete while being poured, and once stretched taut, provides walking surface without further support. Furnished in rolls 4x125 ft. Applied by unrolling over joists and cutting to length, then attaching to end or anchored joist, drawn taut by special stretcher and fastened by clips to intermediate joists. Equally adaptable to floors, roofs and curved surfaces.—Distributed by Johns-Manville Co., 22 E. 40th St., New York City.



12-YD. HYDRAULIC SELF - CONTAINED SCRAPER (below) carrying its own motor, hydraulic pump and primary control apparatus, is constructed throughout of special welded alloy steel assuring lightness of weight as well as strength. Entire power of tractor is used to draw scraper, only connections between two machines being drawbar pin and small electric cable. Digging, carrying and unloading operations are controlled by small electrical push-down switches, positioned at operator's elbow, which actuate hydraulic valves located on scraper. Four hydraulic rams are used to raise and lower pan and front gate and for moving back of pan forward to unload. Load is forced out, not dumped.—Austin - Western Road Machinery Co., Aurora, Ill.



ROAD HARROW loosens up the top surface of oiled or gravel roads preparatory to reconditioning. Road bed is thoroughly covered by 31 staggered teeth with readily reversible and renewable tooth points. Cutter frame is carried by four pins in oblique slots in brackets extending above the runners. By operation of this oblique bracket connection double chain hitch automatically shifts line pull from runners to cutter frame or vice versa as the harrow is lowered to digging position or raised from road bed. Adjustable drag which follows harrow leaves the road immediately usable whether or not subsequent treatment is contemplated. Machine is 6 ft. wide, and weighs 2,200 lb.—Insley Mfg. Co., Indianapolis, Ind.

Tightening he Tightening he Hork to TUNNEL MIDTO TUNNEL With

LOWELL 5 foot

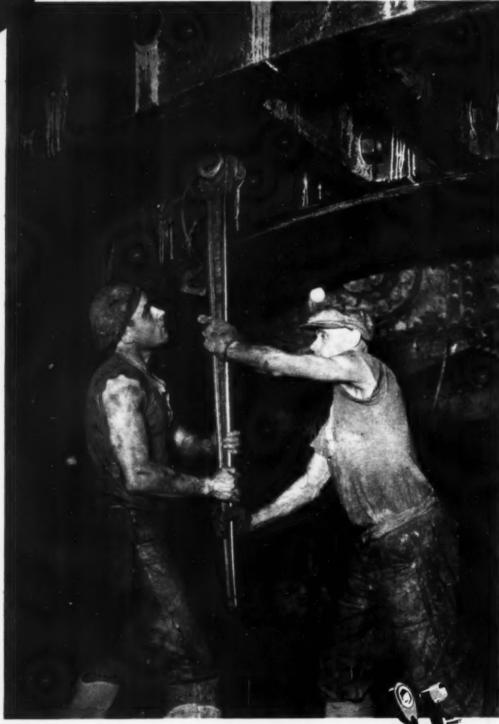
Reversible Ratchet Wrenches

If you want to save time - use

Reversible Ratchet Wrenches

If you want a Wrench that will stand up—take the abuse and if you have regard for the Safety of your men—use the LOWELL for the pawls in these Wrenches have only a crushing strain—the strongest possible construction.

Made and stocked in all sizes from 12 inches to 5 feet long.



Send for Catalog R

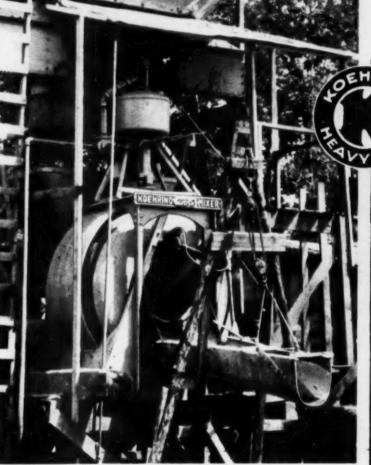
LOWELL WRENCH COMPANY

Worcester, Mass.

KOEHRING

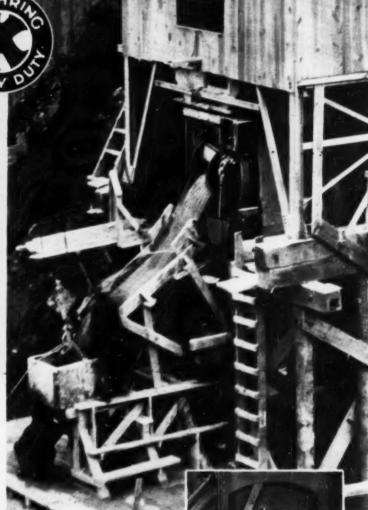
HEAVY DUTY CONSTRUCTION

MIXERS



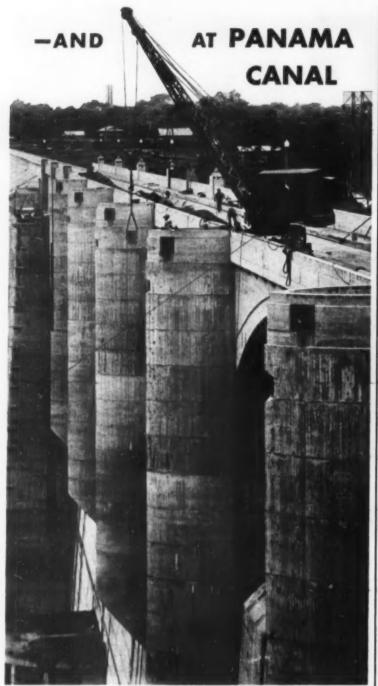
KOEHRING HEAVY DUTY Concrete Construction Mixers are used on a great variety of large volume concrete projects - locks, dams, bridges, power plants, sanitation and water works projects, etc.

Compact design permits minimum installation space. High speed charging and discharging insures maximum production. Heavy Duty Construction results in continuous operation.



The Koehring Flow-Line discharge greatly decreases discharge time - substantially reduces abrasive wear and permits an unbroken, natural

discharge flow of concrete.



BAY CITY Model 38 (Heavy Duty 1/2-5/6 yd.) owned by the Panama Canal

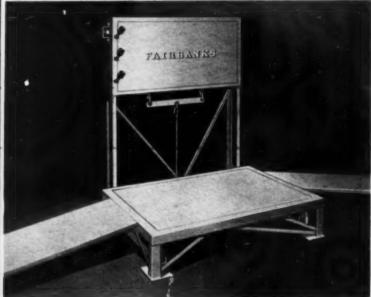
Sturdy, tough and dependable, yet never extreme, Bay City design offers economy of operation and upkeep. Tandem drums with more cable surface permits straight cable lead from drums with any boom or bucket, thus avoiding undue cable wear without off-center pull. Helical cut alloy steel gears insure quiet, smooth operation and longer life. This efficient machinery arrangement and design is standard on all Bay City full-revolving models.

Before you buy your next machine, compare Bay City construction materials, design, accessibility, speed, working ranges and safe load capacity with any machine in the same capacity or weight class. You can't beat Bay City value regardless of what you pay.

Model	Designation	Shovel Weight	Crane Capacit
Tractor	1/8 yard (1/4 Gircle)	20,500	3 ton
27	Heavy Duty 1/8 yard	27,800	5 ton
30	Standard 1/2 yard	30,800	6 ton
38	Heavy Duty 1/2 yard	38,000	7½ ton
42	Standard 1/4 yard	41,000	10 ton
52	Heavy Duty 1 yard	52,400	12½ ton
62		64,000	17½ ton
52-8	1 yard	56,000	15 ton
62.4	11/2 ward	67.000	18 100

BAY CITY, MICH., EASTERN OFFICE: ROSELLE, N. J

a money-saver **FOR EVERY** ONTRACTOR

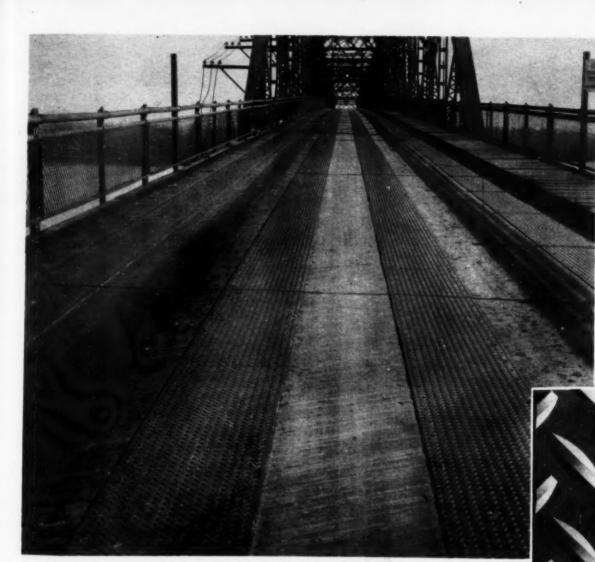


FAIRBANKS AGGREGATE SCALE

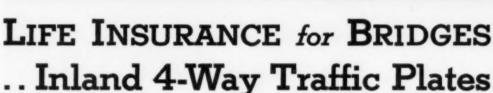
• This portable scale is being found on more and more construction jobs - because it handles so many tasks without getting in the way or slowing up work. It proportions each batch of mix accurately - prevents wasted materials. By combining three beams in one scale, it eliminates extra equipment and speeds up work. Strong in construction and built for hard usage, it is readily portable and can be moved quickly wherever needed. And, best of all, its low price puts it within the reach of every contractor.

Get full information on this money- and time-saving scale today! Address Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. And 40 principal cities—a service station at each house.

Fairbanks Scales



85 tons of Inland 4-Way Traffic Plates used on Mississippi River Bridge at Burlington, lowa



NEW bridges are assured a longer period of service, the useful life of old ones is lengthened, at low cost, by Inland 4-Way Traffic Plates.

Announced in 1931, they were immediately adopted by engineering authorities far and wide, because of the superiority of the 4-Way pattern.

Projections on 4-Way Plates overlap—reinforce—one another both lengthwise and crosswise. Extra stiffness and strength results—extra reinforcement for the bridge floor, giving it a new feeling of safety under the car.

There is equal traction 4-Ways instead of the usual two. Skidding is radically reduced, in bad weather as well as good, for the 4-Way pattern assures thorough drainage.

Inland 4-Way Traffic Plates are made in widths, lengths, and thicknesses for all needs. Write for complete information. INLAND STEEL COMPANY, 38 South Dearborn Street, Chicago, Illinois. Extra Stiffness

4-Way Safety

4-Way Drainage

Sheets Strip Tin Plate
Plates Structurals Piling

Rai

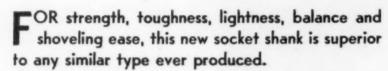
Bar

Rails Track Accessories

Bars Rivets Billets

THE ABW SOCKET SHANK

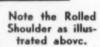
with Rolled Shoulder and Shock Band



Blades and shank are forged from high carbon quality steel and heat treated. It is equipped with the famous ABW Shock Band, which increases the handle strength 21%. The new rolled shoulder not only serves as a convenient and comfortable step, but gives an added strength to the blade.

This great shovel has features of proven merchandising value.

ASK YOUR JOBBER



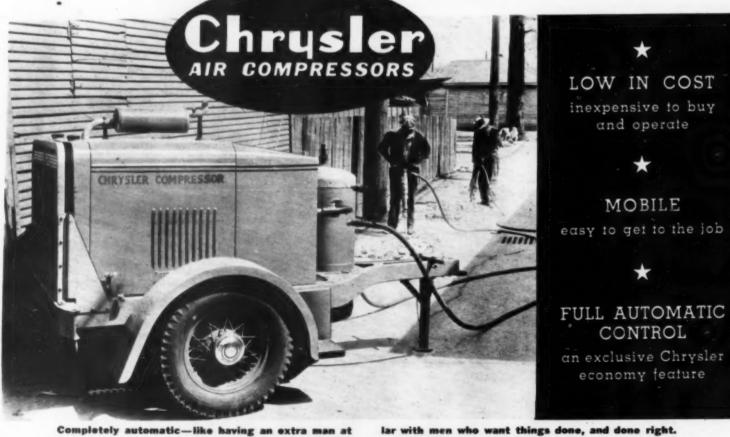




Parkersburg, W. Va.

North Easton, Mass.





the controls . . . the ability to "take it" under all conditions . . . the ability to "give it" in much better than average doses . . . these are but a few of the factors that are making Chrysler Compressors popu-

lar with men who want things done, and done right.

Thousands of hours of operation in all kinds of work prove conclusively that Chrysler Compressors do what they are supposed to do . . . at less cost. Write today for the new completely illustrated catalog.

CHRYSLER CORPORATION . . . AMPLEX DIVISION . . . DETROIT MICHIGAN



Low-Cost Power for Every Job

For the practical solution of your power problems, come to McCormick-Deering. This line of wheel and crawler tractors and stationary power units has thousands of owners and millions of hours of work to recommend it for your use. Whether it be the building or maintaining of roads, or general construction work, you can depend on McCormick-Deering to cut your power costs to the bone. Lay your power requirements before the nearest Inter-

national Harvester branch or McCormick-Deering distributor—let them specify the right size of tractor or power unit for the job. Also have them tell you about the remarkable economy of the McCormick-Deering Diesel engine which is available in the TD-40 TracTracTor and as a power unit.

INTERNATIONAL HARVESTER COMPANY
606 S. Michigan Ave.

OF AMERICA
(Interpretate)
Chicago, Illinois

McCORMICK-DEERING



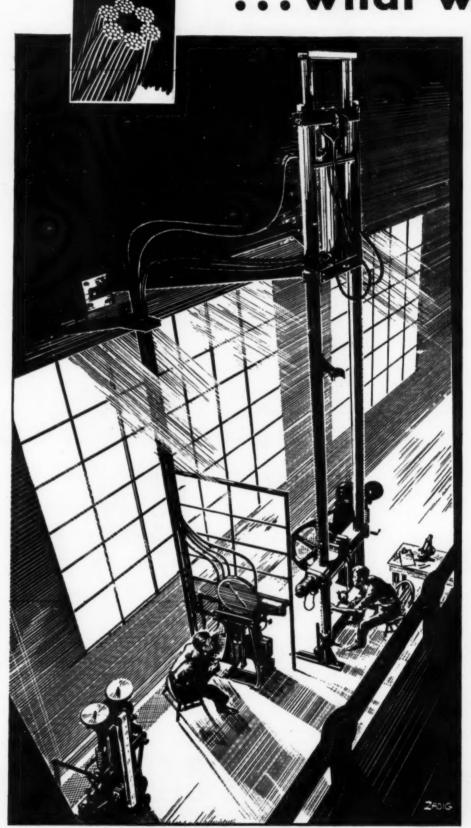
NO TIME WASTED IN NUT TURNING WITH THE "FAVORITE" Contractors on large REVERSIBLE RATCHET engineering projects WRENCH have found the "FAVORITE" an invaluable tool in the quick turning of nuts. Time is saved because the wrench does not leave the nut until operation is completed. A turn of the pawl and motion is reversed for loosening the nut. Nut is encompassed on all sides with socket form of head. Preliminary bolting operations are speeded up with the "FAVORITE." Works on a straight-ahead ratchet movement and can be used in narrower places than an ordinary open-end wrench. TIME-SAVER Each head can turn two different-size nuts, one size on each end. Cadmium finish affords a weather protection. New metal in Handles, Heads and Pawls makes the "Favorite" stronger for rougher all titl usage. 41 REE CHI Send for full particulars. -111 GREENE, TWEED & CO. 111 109 Duane Street Tall I New York, N. Y. ш

FIRM....

Also tell us about your special payment plan as checked

Budget Plan of Deferred Payments
 Rental Plan—Rentals Applying to Purchase

Tomorrow's Wire Rope ... what will it be?



TO MAKE CERTAIN that Roebling Wire Rope will give the user the highest obtainable degree of safe, economical service, Roebling has enlisted the aid of the finest and most complete research, testing and manufacturing facilities. The Roebling fatigue testing machine shown is an example. John A. Roebling's Sons Company, Trenton, N.J. Branches in Principal Cities.

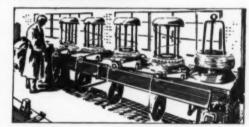
"Some people tell me the world is completed. But I say that behind the scenes, in research laboratories now humming with activity, the world is just in the making."

(From address of a famous industrial executive)

And so in the Roebling Laboratory, one of the country's most modern and completely equipped industrial research units, goes on the ceaseless work of improving Roebling Wire Rope... of developing the wire rope

The 40,000 lbs. capacity "dynamic" fatigue testing machine shown to the left is one of the relatively unknown and costly pieces of equipment in this laboratory. The mechanism at the extreme left of the picture is an automatic regulator and recorder...the only machine of its kind in existence for making fatigue tests of long sections of wire rope.

WIRE DRAWING MILL



An experimental wire mill...right in the Roebling Laboratory. A duplicate, on a small scale, of Roebling's main wire drawing plant. The continuous 5-head wire drawing machine shown is part of the equipment in this experimental wire mill.

ONE OF AMERICA'S FINEST INDUSTRIAL RESEARCH UNITS

An exterior view of the 3-story building devoted entirely to Roebling Research.



ROEBLING ... THE PACEMAKER IN WIRE ROPE DEVELOPMENT

USERS OF BLAW-KNOX

Concrete is mixed both thoroughly and rapidly in Blaw-Knox TRUKMIXERS due to a unique design of deeper mixing blades. Water measurement is reliable and accurate. (Blaw-Knox TRUKMIXERS are easy to operate. Their sturdy construction, freedom from breakdowns and maintenance expense insures economical operation. Write for full details. BLAW-KNOX COMPANY-2086 Farmers Bank Building Pittsburgh, Pa.
Offices and Representatives in Principal Cities C.S.HUNTER CO Truck Mixed Concrets RIVER SAND & SUPPLY CO. HOUSTON-STARR &

Good Roads

ROLLER-BEARING ROCK CRUSHERS

Completely Portable

CRUSHING-SIZING-LOADING PLANTS-FOR STONE OR GRAVEL



CRUSHING SCREENING FEEDING ELEVATING CONVEYING AND WASHING EQUIPMENT

Portable and Stationary plants engineered and built to give desired production requirements

GOOD ROADS MACHINERY CORP.

"Builders of Rock Crushers for 41 years" KENNETT SQUARE PENNSYLVANIA

ND or WET PROCESS Make concrete pipe on the job with Quinn Pipe Forms. Gives employment AT HOME where it is needed. Quinn Pipe Forms can be handled by less experienced labor and produce uniform concrete pipe of highest quality. Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches —tongue and groove or bell end pipe— any length. Backed by years of service in the hands of contractors, municipal de-partments and pipe manufacturers.

Meet the demand for low cost equipment that produces a uniform quality of pipe in smaller amounts. Complete in every way. Stands up on any job. Same size as "Heavy Duty," from 12 to 84 inches-any length.

WRITE TODAY

complete information on prices and ial Construction features of Quinn Forms. Give us size of job for estion your pipe form needs.

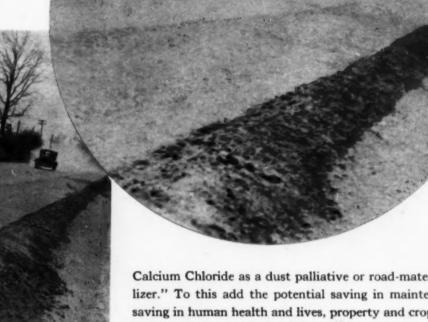
manufacturers of concrete pipe maes for making pipe by machine process

QUINN WIRE & IRON WORKS

BOONE, IOWA

DUST STORMS

like this can be controlled



Shirt

THOSE dust storms which ravaged the western plains last spring were fearsome things. And nothing could be done to curb them.

Though more local, the dust clouds raised by passing vehicles and blown from dirt and loose-gravel roads are relatively even more damaging. Not only are they a detriment to lawns, gardens, orchards and roadside crops . . . they are a real menace to health; obscure motorists' vision and invite accidents; smudge up home interiors, ruin furnishings and exasperate housewives. . . . What's more, they carry away tons of valuable material from every stretch of roadway. (One highway engineer estimates the loss at 115 cubic yards per mile annually on roads carrying 400 vehicles a day.)

Such material loss alone is greater than the cost of saving it. And it can be saved—economically—through the use of

Calcium Chloride as a dust palliative or road-material "stabilizer." To this add the potential saving in maintenance; the saving in human health and lives, property and crops; and the contribution made to the comfort of both motorists and residents.

The maintenance of secondary or "feeder" traffic arteries devolves almost wholly on county and local highway departments. Controlling dust and thus stabilizing and making dirt and gravel road surfaces smoother, easier riding and longer lasting, is one of the wisest measures road officials can take. It not only makes the ruralite's road-tax dollars go farther but evokes his heartfelt gratitude as well.

(Gravel-and-soil stabilization through the moisture bond afforded by Calcium Chloride is now definitely controllable -through formulæ and techniques developed by soil scientists and highway engineers, aided by extensive researches made by the U. S. Bureau of Public Roads.) For free literature on road-dust control and "soil-stabilized" road surfaces, write to any of the following members of the CALCIUM CHLORIDE ASSOCIATION:

The Dow Chemical Company Midland, Michigan The Columbia Alkali Corporation Barberton, Ohio Michigan Alkali Company . . 60 E. 42nd St., New York City Solvay Sales Corporation . . . 40 Rector St., New York City



CALCIUM CHLORIDE





CKSO CONCRETE VIBRATORS

THE vibratory placement of concrete attains peak efficiency with this equipment. Definite savings in cement and labor are effected. The concrete is stronger and denser with better bond between layers and between concrete and reinforcing. Water-tightness is increased. And JACKSON CONCRETE VI-BRATORS, in various sizes and external and internal types, do more jobs and are sturdier, more dependable, easier to handle and more economical to operate and maintain. Furnished with portable power plants if desired. Write for complete details. ELECTRIC TAMPER & EQUIPMENT CO., LUDINGTON, MICH.

4 SIZES

Spades are fur-nished in four models or rises . . . PS-E1, PS-2, PS-3 and PS-4 . . . for various classes of various classes of work. Jackson Portuble Power Plants, for use where power is not available on the job, are also fur-nished in various



In choosing a Finishing Machine for this Ohio job, the contractor selected Flex-Plane, because he could complete the concreting work in one pass. 20 to 34 ft. wide. Four lines of Heltzel Forms were used, with the Flex-Plane Finishing Machine traveling on the outer forms.

FLEXIBLE ROAD JOINT MACHINE CO. Warren, Ohio



The six big trucks of The Paterson-Leitch Company, Cleveland, haul loads of steel—heavy bars that hang out over the sides—big "I" beams—every type of steel. Tires are pounded over rough city pavements—yanked through the mud on construction jobs.

Yet Superintendent Bolz says, "Service from Goodrich Triple Protected Silvertowns has been very satisfactory. Three of our trucks have run over a year without even a puncture. Our tire repair bills average only \$1.38 per truck for the last year." That's the kind of service you have a right to expect from truck tires! Because of a new invention in the sidewall, Silvertowns stand up where other tires fail. This invention—Triple Protection—actually checks 80% of premature tire failures! Think what that means in savings on re-

pair bills—in reduced delays. Here's how Triple Protection adds months to tire life:

1 PLYFLEX—a new. tough, sturdy rubber material with greater resistance to stretch. A layer of Plyflex in the sidewall prevents ply separation—distributes stresses—checks local weakness.

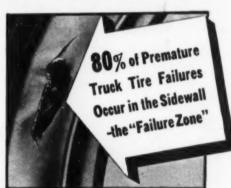
2 PLY-LOCK — the new Goodrich way of locking the plies about the bead. Anchoring them in place, Positive protection against the short plies tearing loose above the bead.

2 100% FULL-FLOATING CORD—Each cord is surrounded by rubber. With ordinary cross-woven fabric, when the cords touch each other, they rub—get hot—break. In Silvertowns, there are no cross cords. No friction.

Try a set of Triple Protected Tires on your toughest job. Prove the dollars and cents savings to your own satisfaction. And remember it costs no more to buy this super-service tire. No premium price.

FREE! 44-PAGE HANDBOOK

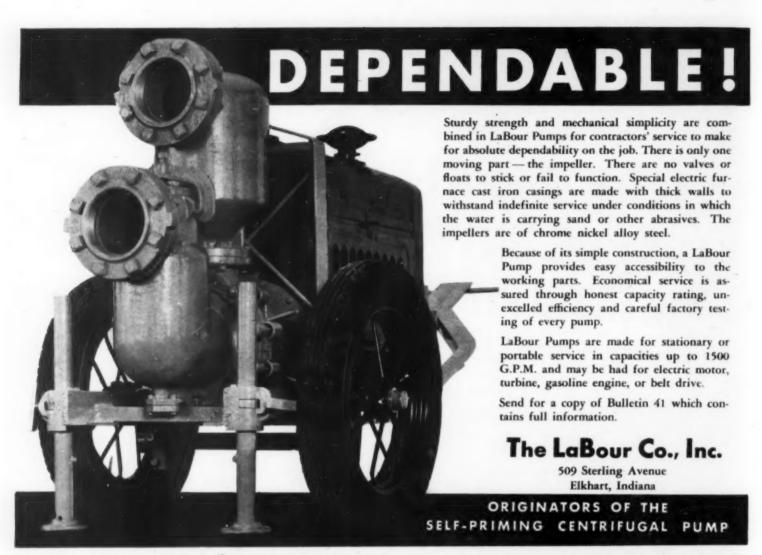
Every truck owner, every driver should have this big 44-page handbook. Gives commodity weights, tire load capacities, inflation schedules, dual spacing chart, load analysis and other useful information. No obligation. Write for free copy. Dept. T-78, The B. F. Goodrich Company, Akron, Ohio.



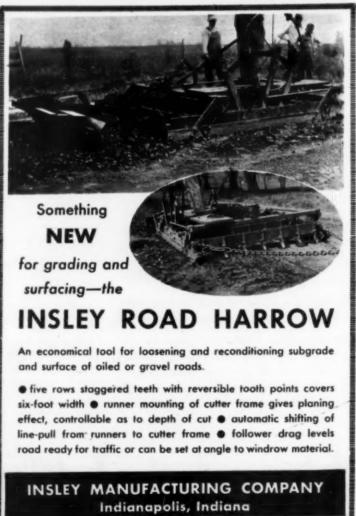


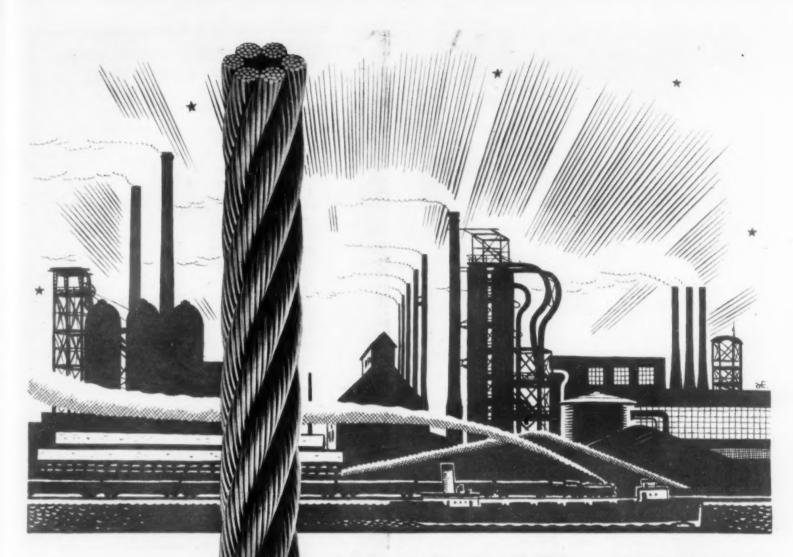
Goodrich Triple Silvertowns

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES









ONE OF THE LARGEST

industrial companies in the United States bought some TRU-LAY Preformed wire rope several years ago. • Since then they have gradually standardized on TRU-LAY—in every branch factory and for practically every wire rope need. • If you want to cut your wire rope costs to the absolute minimum, write us, and we will tell you how you can gain the same dollar-value.

AMERICAN CABLE COMPANY, Inc.

Wilkes-Barre, Pennsylvania

An Associate Company of the American Chain Company, Inc.

IN BUSINESS FOR YOUR SAFETY

ATLANTA • CHICAGO • DENVER • DETROIT • NEW YORK PHILADELPHIA • PITTSBURGH • HOUSTON • SAN FRANCISCO

TRU·LAY Preformed Wire Rope

DISTRICT OFFICES:



Answers to your problems in structural engineering always at your finger tips

EVERY man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods and details.

Hool and Kinne's

Structural Engineers' Handbook Library

6 Volumes—3575 pages—fully illustrated

The most valuable library obtainable for any man concerned with the design and construction of civil engineering structures of any type.

Under the general editorship of George A. Hool, formerly Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin, Editors-in-Chief of the Library, Sixty-Six of the leading, practical operating structural engineers of the United States and Canada give you the very cream of their knowledge of structural engineering.

They give you six well bound, fully illustrated volumes, containing 3,575 pages of practical, authoritative information covering every phase of structural engineering from foundation and substructure work to the completed erection.

Every man concerned with the design and construction of

Every man concerned with the design and construction of civil engineering structures of any type should have these practical books with their helpful tables, diagrams, reference data, best methods information and details. The six books are:—1. Foundations, Abutments and Footings. 2. Structural Members and Connections. 3. Stresses in Framed Structures. 4. Steel and Timber Structures. 5. Movable and Long-Span Steel Bridges, and, 6. Reinforced Concrete and Masonry Structures. With these books on hand you cannot make mistakes.

By placing this Library on your bookshelf you are putting within arm's reach years of actual first rate experience with structural problems. Do not forget either, that these men are all EXPERTS in their lines.

10 DAYS' FREE EXAMINATION

Send us the coupon below, properly filled in, and we will send the Library to you for 10 days' FREE examination. If you examine the books carefully you will want to keep the Library. In that case just send us \$3.50 and then \$3.00 per month until the total price of \$27.50 has been paid.

McGRAW-HILL FREE EXAMINATION COUPON

McGraw-Hitl Book Company, Inc., 330 West 42d Street, New York.

You may send me Hool and Kinne's Structural Engineers' Library for my inspection. If the books prove satisfactory, I will send \$3.50 in 10 days and \$3.00 per month until I have paid the price of the books, \$27.50. If the books are not what I want, I agree to return them postpaid within 10 days of receipt.

Horse Address

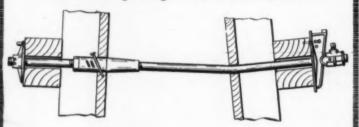
Name of Company

(To insure prompt shipment write plainly and fill in all lines.)

CM- -38

COLT CONCRETE FORM EQUIPMENT

for abutments, bridge decking, dams, disposal plants, columns, etc.



C an be used over and over again.

Only cheap threaded rods left in concrete.

L iked by both skilled and unskilled labor.

Threaded rods can be figured as to strength.

E asily removed before or after stripping forms.

Quickest, simplest and easiest to install.

Unlimited uses for all form conditions.

I t eliminates wooden washers and wedges.

P ushed through forms from the outside.

Made of durable certified malleable iron.

E very user is enthusiastic about results.

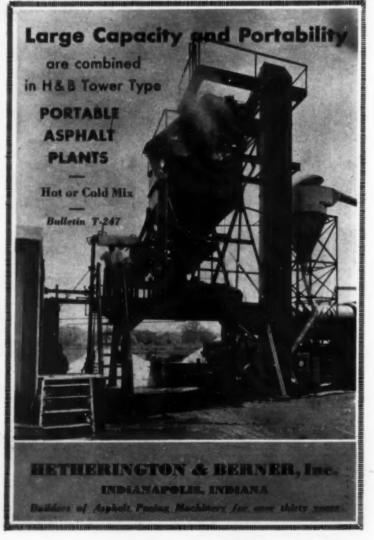
Never has failed and holds perfect alignment.

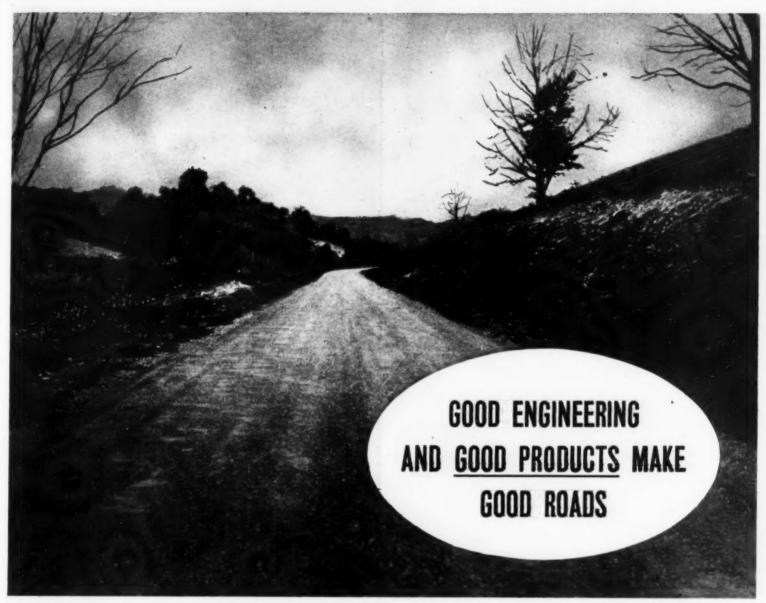
Time saved in labor, and units 100% Salvageable. Colt Cones, Clamps and Nut Washers.

FREDERICK N. RITCHIE CO.

113 No. Centre St.

Orange, N. J.





Standard Brand Socony Cut Back Asphalt, surface treatment on gravel base, Tompkins County Road near Ithaca, New York



Standard Asphalt Road Oils
Standard Asphalt Joint Fillers
Standard Waterproofing Asphalt
Standard Cut-Back Surfacing Asphalt
Standard Asphalt Binder A for surface treatment
Standard Refined Asphalt for sheet asphalt paving
Standard Cold Patch Asphalt for all types of patching
Standard Asphalt Binders B & C for penetration work
(Asphalt Macadam)

Standard Paving Asphalt 51-60 and 61-70 Penetration for the mixing method (Asphaltic Concrete)

Standard Asphalt Emulsion for Surface Treatment, Penetration, Road and Plant Mix, and Patching

Specifications and all other particulars furnished on request.

SOCONY-VACUUM OIL CO.

INCORPORATED
STANDARD OIL OF NEW YORK DIVISION

ON THE JOB AT SAN ACACIA, N. Mex.

24 Hours Per Day Service Without Repair Cost



WHEN pumps are 2,000 miles from home, far removed from factory service, they must have that built-in-stamina which makes them dependable; they must be of unusual simplicity to render trouble free, continuous 24 hour daily service. G&R Pumps do render 24 hour daily continuous service day after day, month after month. That was the experience of the construction associates of Mr. G. Gebman, Purchasing Agent of the Middle Rio Grande Conservancy District, Albuquerque, when he writes:-

> "The 4" pump was transferred to our El Vado Division and has seen practically continuous service. The two 6" pumps were used 24 hours per day for approximately four months on our San Acacia Dam.

"We have remarked several times about the wonderful service these pumps have given us without any repair cost and we want to assure you that we are more than pleased with the way they have stood up. Our construction program should be completed within the next two to three months."

What further evidence is needed of the DEPENDABLE, ECON-OMICAL and TROUBLE FREE SERVICE OF G & R PUMPS? Such service explains why G&R PUMPS are today the FASTEST SELLING, SELF PRIMING CENTRIFUGALS. Wherever you go, from Maine to Washington; from Florida to California, and even down into Mexico, you will find G & R PUMPS "ON THE JOB WITH A STEADY THROB."

SOLD BY 100 DISTRIBUTORS IN PRINCIPAL CITIES

THE GORMAN-RUPP CO.

Mansfield, Ohio

WATER-PROOFING

with











- Water conc to enlarged bleeder holes by Sika #4A.
- Two bleeder holes plugged by Sika #2. Infiltrations concenrated to bleeders.
- Inserting Sika #2 in-to last bleeder hole.
- All bleeder holes plugged with Sika #2, and rimmed to
- Protective coat of Sika #1 cement plas-

Use Sika

to stop water inflow through any masonry. Sika mixed with part-land cement easily ap-plied by hand — seals off infiltration from unrground streams even

Write us about your problems







Sika, Inc. 1943 Grand Central Terminal

New York City



BAKER

Long life on the job is a characteristic of Baker Bulldozers. There is less wear and tear because of the twin-cylinder, direct-lift operation which cuts down the number of wearing

parts. Smooth, fast operation and

great strength with less "time out" on the job account for the growing list of Baker Bulldozer owners.

Ask for Bulletins On Baker Bulldozers and Gradebuilders.

THE BAKER MFG. CO.

568 Stanford Ave.

BAKER

TRACTOR

EQUIPMENT

also includes

TRACTOR SCRAPERS ROAD DISCS

ROAD ROOTERS SNOW PLOWS

Springfield, Ill.



• If you're going to make a profit, you've got to know what your equipment will do—that it will move dirt and rock within your bid price and contract limit. That's why successful contractors use tried equipment—LeTourneau equipment. Designed by a contractor to whip his own tough jobs—building the Boulder Dam Highway and such like projects—LeTourneau equipment has since been proved on hundreds of jobs throughout the world, from Hawaii to Iraq. On Le Tourneau equipped jobs, "guesstimating" is

eliminated, dirt moves fast, costs are cut low and profits upped.

Ask our Engineers what LeTourneau job proved equipment can do for you

R. G. LETOURNEAU, INC.

Peoria, Illinois

Stockton, California

Manufacturers:

Angledozers, Bulldozers, Sheep's Foot Rollers, Power Control Units, Buggies, Rooters, Carryall Scrapers, Derricks, Trailers.

ETULIRNEAL



do for the Forest Lawn emorial Park at Glende California. These are of 8 Carryalls on the

There is no Doubt about the load on this line.

It has been definitely determined with a Martin-Decker Cable Tension Indicator. Excessive strain has been eliminated.

You can learn the load on every line on the job with one of these instruments.

Two sizes, for cables from $\frac{1}{4}$ " to $2\frac{3}{8}$ " in diameter; loads up to 260,000 lb.

MARTIN-DECKER CORPORATION

3441 Cherry Ave. P. O. Box 571 Long Beach, Calif. U. S. A.



SPONGEX

SPONGE RUBBER SEAT CUSHIONS

SADDLE OR BOX TYPE

Provide a cushion for every seat. Spongex Cushions are all sponge rubber construction. They last far longer than spring cushions and give superior riding ease and protection.

SPONGE RUBBER PRODUCTS CO. DERBY, CONNECTICUT

SPONGE RUBBER PRODUCTS CO., Dept. M, Derby, Conn.

Please send me your booklet, "A New Way to Ride on Rubber."

I am interested in Spongex Cushions for Tractors
Road Machinery
Trucks ...

NAME ..

ADDRESS ...

TITLE ..

EQUIPMENT and MATERIALS

An index of products made by manufacturers whose advertisements appear in this issue of Construction Methods.

ASPHALT

Socony-Vacuum Oil Co., Inc.

ASPHALT PLANTS Blaw-Knox Company Hetherington & Berner, Inc.

BACK FILLERS

Austin-Western Road Mchy. Co. Harnischfeger Corp. Northwest Engineering Co.

BARS, IRON AND STEEL

Carnegie Steel Company Illinois Steel Co. Inland Steel Co.

BATCHERS, ADJUSTABLE MEAS-

Blaw-Knox Company

BELTING

Goodrich Rubber Co., B. F.

BINS, STORAGE

Blaw-Knox Company

BLASTING ACCESSORIES

Atlas Powder Co. Ensign-Bickford Co.

BOLTS, NAILS, NUTS, RIVETS and

Illinois Steel Co. Inland Steel Co.

BOOKS, ENGR. and TECHNICAL

McGraw-Hill Book Co.

BUCKETS

Blaw-Knox Company Bucyrus-Erie Co. Harnischfeger Corp. Insley Mfg. Company Link-Belt Co.

Northwest Engineering Co.

BUILDINGS, STEEL

Blaw-Knox Company

BULLDOZERS

Baker Mfg. Co. Continental Roll & Steel Fdry Co. Le Tourneau, Inc., R. G. Roebling's Sons Co., J. A.

CABLEWAYS

Roebling's Sons Co., J. A.

CALCIUM CHLORIDE

Calcium Chloride Assn.

CEMENT

International Cement Corp. Universal Atlas Cement Co.

CEMENT (BULK) HANDLING EQUIP.

Blaw-Knox Company Barber-Greene Co.

CHUTES, CONCRETE

Insley Manufacturing Co.

COMPRESSORS, AIR Allis-Chalmers Mfg. Co. Amplex Mfg. Co.

If you do not find all you need in the advertising section, we shall be glad to assist you. Write to —

CONSTRUCTION METHODS

Information Bureau

330 West 42nd St.

New York City

CONCRETE CURING MATERIAL Calcium Chloride Assn. CONCRETE REINFORCEMENT

Carnegie Steel Company Illinois Steel Co. Inland Steel Co.

Wickwire Spencer Steel Co.

CONCRETE SLAB RAISING EQUIP-MENT

Koehring Company

CONVEYING & STORAGE SYS-

Barber-Greene Co.

Link Belt Co.

CONVEYORS, BELT, BUCKET & CHAIN

Barber-Greene Co. Link Belt Co.

Wickwire Spencer Steel Co.

CRANES, GAS, ELECTRIC, DIESEL

American Hoist & Derrick Co. Austin-Western Road Mchy. Co. Bay City Shovels, Inc.

Bucyrus-Erie Co. Harnischfeger Corp. Koehring .Company

Link Belt Co. Northwest Engr. Co.

CRUSHERS & PULVERIZERS

Acme Road Mchry. Co. Allis-Chalmers Mfg. Co Austin-Western Road Mchy. Co. Good Roads Mchry. Co.

Gruendler Crusher & Pulveriser Co.

Austin-Western Road Mchy. Co.

CUSHIONS, RUBBER

Sponge Rubber Prodts. Co.

DERRICKS & DERRICK FITTINGS American Hoist & Derrick Co.

Harnischfeger Corp.

DRAGLINES

(See Cranes & Shovels)

Bucyrus-Erie Co. Harnischfeger Corp. Link Belt Co.

DRILLS, WAGON

Bucyrus-Erie Co.

Atlas Powder Co.

ELEVATORS, BUCKET

Link Belt Co.

ELEVATORS, CONTR. MATERIAL Barber-Greene Co.

ENGINES, PORTABLE

Allis-Chalmers Mfg. Co. Amplex Mfg. Co. Fairbanks, Morse & Co.

ENGINES, STATIONARY, DIESEL

Caterpillar Tractor Co.

Fairbanks, Morse & Co.

EXCAVATORS, DITCH & TRENCH

American Hoist & Derrick Co. Baker Mfg. Co. Barber-Greene Co. Bay City Shovels, Inc.

Bucyrus-Erie Co. Harnischfeger Corp

Koehring Company.

Link Belt Co. Northwest Engr. Co.

EXCAVATORS, DRAGLINE Austin-Western Road Mchy. Co. Bay City Shovels, Inc.

Bucyrus-Erie Co. Harnischfeger Corp. Insley Mfg. Company

Koehring Company. Link Belt Co. Northwest Engr. Co.

EXPLOSIVES

Atlas Powder Co.

FLOOR PLATES STEEL

Carnegie Steel Co.

Inland Steel Co.

FORMS, CONCRETE

Blaw-Knox Company

FORMS, PIPE

Quinn Wire & Iron Wks.

FORMS, CLAMP Ritchie Co., F. N.

FUSE, BLASTING Ensign-Bickford Co.

GENERATORS, ELECTRIC

Electric Tamper & Equip. Co. Fairbanks, Morse & Co.

GRADERS, ROAD

Acme Road Mchry. Co. Allis-Chalmers Mfg. Co. Austin-Western Road Mchy. Co. Blaw-Knox Company

Caterpillar Tractor Co. Good Roads Mchry. Co.

GRAVEL WASHING PLANTS

Austin-Western Road Mchy. Co.

GUARD RAILS, HIGHWAY Hazard Wire Rope Co. Wickwire Spencer Steel Co.

HOISTS, GAS, ELECTRIC, DIESEL & STEAM

Allis-Chalmers Mfg. Co. American Hoist & Derrick Co. Fairbanks, Morse & Co.

Harnischfeger Corp. Sterling Machinery Corp.

HOISTS, HAND

Sterling Machinery Corp.

HOSE, AIR

Goodrich Rubber Co., B. F.

Flexible Road Joint Machine Co.

LATH, EXPANDED METAL

Wickwire Spencer Steel Co.

LIGHTING PLANTS

Truscon Steel Co.

Fairbanks, Morse & Co.

Hutchison Engrg. Works Sterling Machinery Corp.

LINER PLATES, STEEL Blaw-Knox Company

LOADERS, PORTABLE

Barber-Greene Co. Link Belt Co.

LUBRICANTS

Gulf Refining Co.

Socony-Vacuum Oil Co., Inc.

MAINTAINERS, ROAD Allis-Chalmers Mfg. Co.

Austin-Western Road Mchy. Co.

MIXERS, CONCRETE & MORTAR

Jaeger Machine Co.

Koehring Company MIXERS. PAVING

Koehring Company

MIXERS, TRUCK

Blaw-Knox Company Jaeger Machine Co.

MIXING PLANTS, CENTRAL

Blaw-Knox Company Jaeger Machine Co.

MOTORS, ELECTRIC

Fairbanks, Morse & Co. Harnischfeger Corp.

PAINTS, WATERPROOFING

Sika, Inc.

PAVING, COLD PATCHING

Koppers Products Co. Socony-Vacuum Oil Co., Inc.

PAVING, HAND TOOLS L & M Mfg. Co.

PHE DRIVERS

American Hoist & Derrick Co.

Harnischfeger Corp.

PILING, INTERLOCKING STEEL

Carnegie Steel Company Illinois Steel Co. Inland Steel Co.

PIPE FORMS, CONCRETE
Ouinn Wire & Iron Wks.

PIPF INSTALLATION METHODS Hydranger Corp.

POWDER
Atlas Powder Co.

PUMPS, PORTABLE
Fairbanks, Morse & Co.
Gorman-Rupp Co.
Jaeger Machine Co.
La Bour Company.
Moretrench Corp.
Sterling Machinery Corp.

PUMPS, STATIONARY
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
La Bour Company.
Sterling Machinery Corp.

RAILS & RAIL JOINTS, FASTEN-INGS & SPECIALTIES Carnegie Steel Company

ROAD OILS & PRESERVATIVES Socony-Vacuum Oil Co., Inc.

ROAD FINISHERS, CONCRETE Blaw-Knox Company Flexible Road Joint Machine Co.

ROAD SURFACING HARROWS Insley Manufacturing Co. ROLLERS, ROAD
Austin-Western Road Mchy. Co.

ROPE, WIRE
American Cable Co.
Hazard Wire Rope Co.
Roebling's Sons Co., J. A.
Wickwire Spencer Steel Co.

SAW RIGS, PORTABLE Sterling Machinery Corp.

SCALES, WEIGHING & PROPOR-TIONING Fairbanks, Morse & Co.

SCRAPERS, SCARIFIERS & PLOWS
Austin-Western Road Mchy, Co.
Baker Mfg. Co.
Continental Roll & Steel Fdry Co.
Euclid Road Mchry. Co.
Harnischfeger Corp.

SCREENS, SAND, GRAVEL & COAL Acme Road Mchry. Co. Gruendler Crusher & Pulveriser Co. Link Belt Co. Wickwire Spencer Steel Co.

SEATS, RUBBER Sponge Rubber Prodts. Co.

SHOVELS, HAND Ames Baldwin Wyoming Co.

SHOVELS, POWER
American Hoist & Derrick Co.
Austin-Western Road Mchy. Co.
Bay City Shovels, Inc.
Bucyrus-Erie Co.
Harnischfeger Corp.
Insley Manufacturing Co.
Koehring Company.
Link Belt Co.
Northwest Engr. Co.

SNOW PLOWS & LOADERS
Austin-Western Road Mchy. Co.
Baker Mfg. Co.

SPREADERS, BITUMINOUS SUR-FACE

Barber-Greene Co. Jaeger Machine Co.

STEEL, STRUCTURAL Carnegie Steel Company

TENSION INDICATOR Martin Decker Corp.

TIRES, TRUCK Goodrich Rubber Co., B. F.

TRACKS, INDUSTRIAL & PORTABLE

Carnegie Steel Company Illinois Steel Co.

TRACTORS, DIESEL & GAS

Allis-Chalmers Mfg. Co. Austin-Western Road Mchy. Co. Caterpillar Tractor Co. Cleveland Tractor Co. International Harvester Co.

TRAILERS, DUMP & CRAWLER WHEEL

Allis-Chalmers Mfg. Co. Austin-Western Road Mchy. Co. Euclid Road Mchy. Co. LeTourneau, Inc., R. G.

For page reference see advertisers index, page 74

TRUCKS, MOTOR
Euclid Road Mchy, Ca

Euclid Road Mchy. Co. Hug Company, The International Harvester Co.

VIBRATORS, CONCRETE Electric Tamper & Equip. Co.

WAGONS, DUMP & CRAWLER WHEEL
Allis-Chalmers Mfg. Co.
Austin-Western Road Mchy. Co.
Euclid Road Mchy. Co.
Koehring Company
LeTourneau, Inc., R. G.

WATERPROOFING Sika, Inc.

WELDING & CUTTING APPARS.

Harnischfeger Corp.

Hobart Bros. Co.

WELDING RODS & WIRE Roebling's Sons Co., J. A. Wickwire Spencer Steel Co.

WELLPOINT SYSTEMS

Complete Mchry. & Equip. Co., Inc.
Moretrench Corp.

WIRE ROPE ACCESSORIES Roebling's Sons Co., J. A.

WRENCHES
Greene-Tweed & Co.
Lowell Wrench Co.

MORETRENCH PUMPS

(the strongest and most durable pump ever made)

WITH

MORETRENCH WELLPOINTS

(the point that has dried up three thousand wet jobs all over the world)

AND

MORETRENCH KNOW-HOW

(pioneers in the wellpoint business with world-wide experience)

GET

MORETRENCH RESULTS

(the Moretrench Wellpoint System makes every job a dry job

MORETRENCH CORPORATION

Sales Office: 90 West St., New York City Works: Rockaway, New Jersey



SERVICE

onstruction

SECTION





For Underground Installation of Pipe and Conduits.

Avoids damage to costly pavements and saves time.

Send for Bulletin.

Send for Bulletin.

HYDRAUGER CORPORATION, LTD.

San Francisco, California



GRUENDLER PORTABLE ROCK AND GRAVEL CRUSH -ING AND SCREENING PLANTS

In sizes from 300 to 2500 tons daily; also manufacturers of crushers, revolving screens, shaker screens, elevators, conveyors — complete material handling equipment.

LOW COST OPERATING EQUIPMENT

GRUE IDLER CRUSHER A PULVERIZER CO. Dept. C.M. Saint Louis, Mo.

"ACME" ROAD MACHINERY
Heavy Duty_Larger Capacity_Langer Life_
Try a new Acme Reduction Crusher or a new Acme
H. D. Roller Screen on your new job.
Guaranteed rebuilt or used equipment available on attractive lease or sales contract.
For Satisfaction and Service use Genuine "ACME"
Parts. Communicate with nearest Dealer, main office—
Frankfort, N. Y. or 120 Liberty St., New York City.

COMPLETE **WELL POINT SYSTEMS**

WILL DRY UP ANY **EXCAVATION**

Faster-More Economically

BMPLETE

MACHINERY & EQUIPMENT CO., Inc. 36-36 lith St., Long Island City, N. Y. Tel. IRonsides 6-8600

ELECTRIC LIGHTING PLANTS



\$375.00 co COMPLETE LINE!



HUTCHISON ENGINEERING WORKS 549 Washington Blvd., Chicago, III.

A SIMPLE FACT. EASILY OVERLOOKED

Among the 20,000 and more readers of Construction Methods, other men who glance at this section, as you are doing. are also interested in anything that has a part in efficient and economical construction operations. How logical, then, to convey information of appropriate construction equipment, accessories and other products used in construction to these men - through advertising right here on this page - a simple fact, easily overlooked.

FOR FULL INFORMATION
ADDRESS
Departmental Advertising Staff

CONSTRUCTION METHODS 330 West 42nd St. New York City

CONSTRUCTION METHODS ADVERTISERS IN THIS ISSUE

Fairbanks Morse & Co

Acme Road Mchy. Co	74
Allis-Chalmers Mfg. Co Center Spre	ead
American Cable Co	67
American Hoist & Derrick Co	6
Ames Baldwin Wyoming Co	58
Amplex Mfg. Co	58
Atlas Powder Co	18
Austin-Western Road Mchy. Co	21
Baker Mfg. Co	70
Barber-Greene Co	10
Blaw-Knox Company	62
Bay City Shovels, Inc	56
Bucyrus-Erie Co	12
Calcium Chloride Assn	63
Carnegie Steel Co	16
Caterpillar Tractor Co	9
Cleveland Tractor Co 4th Co.	ver
	63
Complete Mchry. & Equip. Co., Inc	74
Continental Roll & Steel Fdry. Co	64
Dow Chemical Co	63
Electric Tamper & Equip. Co	
Ensign-Bickford Co 2nd Cov	er
Euclid Road Mchy. Co	5

rantbanks, moise or co	10
Flexible Road Joint Machine Co	64
Goodrich Rubber Co., B. F	65
Good Roads Mchy. Co	62
Gorman-Rupp Company	70
Greene, Tweed & Co	60
Gruendler Crusher & Pulverizer Co	74
Gulf Refining Co	13
Harnischfeger Corp	19
Hazard Wire Rope Co 3rd Co	ver
Hetherington & Berner, Inc	68
Hobart Bros. Co	60
Hug Company	20
Hutchison Engrg. Wks	74
Hydrauger Corp., Ltd	74
Illinois Steel Co	8
Inland Steel Co	57
Insley Manufacturing Co	66
International Cement Corp	7
International Harvester Co	59
Jaeger Machine Co	17
Koehring Company	55

La Bour Company	66
Le Tourneau, R. G	71
L & M Mfg. Company	
Link-Belt Company	
Lowell Wrench Co	54
McGraw-Hill Book Co	68
Martin Decker Corp	71
Michigan Alkali Co	63
Moretrench Corp	73
Northwest Engineering Co	11
Quinn Wire & Iron Wks	62
Ritchie Co., Frederick N	68
Roebling's Sons Co., J. A	61
Rogers Bros. Corp.	74
Service Section	74
Sika, Inc.	70
Socony-Vacuum Oil Co., Inc	69
Solvay Sales Co	63
Sponge Rubber Products Co	71
Sterling Machinery Corp	66
U.S. Steel Corp. Subsidiaries 8-16-	22
Universal Atlas Cement Co	22
Wickwire Spencer Steel Co	15

GALIEN SKIP HOIST, HANDLING 400 CARS OF COAL PER SEASON, EQUIPPED WITH 3/" LAY-SET PREFORMED ROPE

NON-PREFORMED WIRE ROPES USED ON THIS HOIST LASTED FROM 9 TO 11 MONTHS . . .

THE LAY-SET PREFORMED ROPE NOW IN USE HAS BEEN IN STEADY SERVICE FOR OVER 18 MONTHS!

WRITE FOR YOUR FREE COPY OF "TWELVE BURNING QUESTIONS"



HAZARD WIRE ROPE COMPANY, Inc.

Wilkes-Barre, Pennsylvania
An Associate Company of the American Chain Company, Inc.

In Business for Your Safety

District Offices: New York Chicago
Philadelphia Pittsburgh Ft. Worth San Francisco
Denver Los Angeles Birmingham Tacoma



LAY-SET Preformed Wire Rope

A CLETRAC 80 DIESEL LOADS

AN 8-9 YARD WAGON IN...

3 Jaconds!

THIS Cletrac 80 Diesel pulling a 48" elevating grader on a new loop levee construction near Snow Lake, Arkansas, made a record of loading an 8-9 yard wagon in 37 seconds. • In damp, buckshot soil, the plow disc was set to cut 30". This outstanding performance was the deciding factor in the purchase of three additional Cletrac 80 Diesels by the owner. • Your Cletrac dealer can show you many similar records of Cletrac performance on your type of work. THE CLEVELAND TRACTOR CO., Cleveland, Ohio



CLETRAC CRAWLER TRACTORS